

# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit: 1763

162 N. Wolfe Road

(408) 530-9700

Sunnyvale, CA 94086

Customer No.: 28960

TRANSMITTAL LETTER

Examiner:

_		• •	. •	
In re	An	nlıc	ation	01:

Thomas W. Kenny et al.

Serial No.: 10/643,684

Filed: August 18, 2003

For:

APPARATUS AND METHOD OF

FORMING CHANNELS IN A HEAT-EXCHANGING DEVICE

Commissioner for Patents P.O. Box 1450

Alexandria, VA 22313

Sir:

Enclosed please find an Information Disclosure Statement and Form PTO-1449, including copies of the references contained thereon, for filing in the U.S. Patent and Trademark Office.

You will also find enclosed the associated Transmittals, Electronic Information Disclosure Statements, and United States Patent and Trademark Office Acknowledgment Receipts for the electronically filed Information Disclosure Statement (EFS ID #59981); (EFS ID #59983) and (EFS ID #59986) filed on April 28, 2004.

The Commissioner is hereby authorized to charge any additional fee or credit overpayment to our Deposit Account No. <u>08-1275</u>. An originally executed duplicate of this transmittal is enclosed for this purpose.

Respectfully submitted,

HAVERSTOCK & OWENS LLP

Dated:

Thomas R

Thomas B. Haverstock

Reg. No.: 32,571

Attorneys for Applicants

### CERTIFICATE OF MAILING (37 CFR§ 1.8(a))

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the U.S. Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to the: Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450

HAVERSTOCK & OWENS LLP.

Date: \_T



## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Group Art Unit: 1763
Thomas W. Kenny et al.	Examiner:
Serial No.: 10/643,684	) ) ) INFORMATION DISCLOSURE
Filed: August 18, 2003	STATEMENT
For: APPARATUS AND METHOD OF FORMING CHANNELS IN A HEAT-EXCHANGING DEVICE	) ) 162 N. Wolfe Road ) Sunnyvale, CA 94086 ) (408) 530-9700

Commissioner for Patents P.O. Box 1450 Alexandria, VA 22313

Sir:

The citations listed below, copies attached, may be material to the examination of the above-identified application, and are therefore submitted in compliance with the duty of disclosure defined in 37 C.F.R. §§ 1.56 and 1.97. The Examiner is requested to make these citations of official record in this application.

United States Patents or Published Patent Applications have been filed electronically (EFS ID #59981); (EFS ID #59982); (EFS ID #59983) and (EFS ID #59986). Applicants have become aware of the following printed publication which may be material to the examination of this application:

- Chinese Publication No. CN 97212126.9;
- Japanese Patent Abstract JP 2000-277540;
- Stephen C. Jacobson et al., "Fused Quartz Substrates for Microchip Electrophoresis", Analytical Chemistry, Vo. 67, No. 13, July 1, 1995, pages 2059-2063;
- Kendra V. Sharp et al., "Liquid Flows in Microchannels", 2002, Vol. 6, pages 6-1 to 6-38;
- Shuchi Shoji et al., "Microflow devices and systems", J. Microcech. Microeng. 4 (1994), pages 157-171, printed in the U.K;

 Angela Rasmussen et al., "Fabrication Techniques to Realize CMOS-Compatible Microfluidic Microchannels", Journal of Microelectromechanical, Vo. 10, No. 2, June 2001, pages 286-297;

- J. H. Wang et al., "Thermal-Hydraulic Characteristic of Micro Heat Exchangers", 1991, DSC-Vol. 32, Micromechanical Sensors, Actuators, and Systems, pages 331-339;
- Gad Hetsroni et al., "Nonuniform Temperature Distribution in Electronic Devices Cooled by Flow in Parallel Microchannels", IEEE Transactions on Components and Packaging Technologies, March 2001, Vol. 24, No. 1, pages 16-23;
- X. F. Peng et al., "Heat Transfer Characteristics of Water Flowing through Microchannels", Experimental Heat Transfer An International Journal, Vol. 7, No. 4, October-December 1994, pages 265-283;
- Linan Jiang et al., "Forced Convection Boiling in a Microchannel Heat Sink", Journal of Microelectromechanical Systems, Vol. 10, No. 1, March 2001, pages 80-87;
- Muhammad M. Rahman et al., "Experimental Measurements of Fluid Flow and Heat Transfer in Microchannel Cooling Passages in a Chip Substrate", 1993, EEP-Vol. 4-2, Advances in Electronic Packages, pages 685-692;
- X. F. Peng et al., "Forced convection and flow boiling heat transfer for liquid flowing through Microchannels", 1993, Int. J. Heat Mass Transfer, Vol. 36, No. 14, pages 3421-3427;
- Lung-Jieh Yang et al., "A Micro Fluidic System of Micro Channels with On-Site Sensors by Silicon Bulk Micromaching", September 1999, Microfluidic Devices and Systems II, Vol. 3877, pages 267-272;
- G. Mohiuddin Mala et al., "Heat transfer and fluid flow in microchannels", 1997, Int. J. Mass transfer, Vol. 40, No. 13, pages 3079-3088, printed in Great Britain;
- J. M. Cuta et al., "Fabrication and Testing of Micro-Channel Heat Exchangers", SPIE Microlithography and Metrology in Micromaching, Vol. 2640, 1995, pages 152-160;

- Linan Jiang et al., "A Micro-Channel Heat Sink with Integrated Temperature Sensors for Phase Transition Study", 1999, 12<sup>th</sup> IEEE International Conference on Micro Electro Mechanical Systems, pages 159-164;
- Linan Jiang et al., "Fabrication and characterization of a microsystem for a micro-scale heat transfer study", J. Micromech. Microeng. 9 (1999) pages 422-428, printed in the U.K;
- M. B. Bowers et al., "High flux boiling in low flow rate, low pressure drop mini-channel and micro-channel heat sinks", 1994, Int. J. Heat Mass Transfer, Vol. 37, No. 2, pages 321-332;
- Yongendra Joshi, "Heat out of small packages", December 2001, Mechanical Engineer, pages 56-58;
- A. Rostami et al., "Liquid Flow and Heat Transfer in Microchannels: a Review", 2000, Heat and Technology, Vol. 18, No. 2, pages 59-68;
- Lian Zhang et al., "Measurements and Modeling of Two-Phase Flow in Microchannels with Nearly Constant Heat Flux Boundary Conditions", Journal of Microelectromechanical Systems, Vol.11, No. 1, February 2002, pages 12-19;
- Muhammad Mustafizur Rahman, "Measurements of Heat Transfer in Microchannel Heat Sinks", Int. Comm. Heat Mass Transfer, Vol. 27, No. 4, May 2000, pages 495-506;
- Issam Mudawar et al., "Enhancement of Critical Heat Flux from High Power Microelectronic Heat Sources in a Flow Channel", Journal of Electronic Packaging, September 1990, Vol. 112, pages 241-248;
- Nelson Kuan, "Experimental Evaluation of Micro Heat Exchangers Fabricated in Silicon", 1996, HTD-Vol. 331, National Heat Transfer Conference, Vol. 9, pages 131-136;
- E. W. Kreutz et al., "Simulation of micro-channel heat sinks for optoelectronic microsystems", Microelectronics Journal 31(2000) pages 787-790;
- J. C. Y. Koh et al., "Heat Transfer of Microstructure for Integrated Circuits",
   1986, Int. Comm. Heat Mass Transfer, Vol. 13, pages 89-98;
- Snezana Konecni et al., "Convection Cooling of Microelectronic Chips",
   1992, InterSociety Conference on Thermal Phenomena, pages 138-144;

- Michael B. Kleiner et al., "High Performance Forced Air Cooling Scheme Employing Microchannel Heat Exchangers", 1995, IEEE Transactions on Components, Packaging, and Manufacturing Technology-Part A, Vol. 18, No. 4, pages 795-804;
- Jerry K. Keska Ph. D. et al., "An Experimental Study on an Enhanced Microchannel Heat Sink for Microelectronics Applications", EEP-Vol. 26-2, Advances in Electronic Packaging, 1999, Vol. 2, pages 1235-1259;
- Shung-Wen Kang et al., "The Performance Test and Analysis of Silicon-Based Microchannel Heat Sink", July 1999, Terahertz and Gigahertz Photonics, Vol. 3795, pages 259-270;
- Joseph C. Tramontana, "Semiconductor Laser Body Heat Sink", Xerox
   Disclosure Journal, Vol. 10, No. 6, November/December 1985, pages 379-381;
- Sarah Arulanandam et al., "Liquid transport in rectangular microchannels by electroosmotic pumping", Colloid and Surfaces A: Physicochemical and Engineering Aspects 161 (2000), pages 89-102;
- Jeffery D. Barner et al., "Thermal Ink Jet Print Head Carriage with Integral Liquid Cooling Capabilities", Xerox Disclosure Journal-Vol. 21, No. 1, January/February 1996, pages 33-34;
- "Autonomous displacement of a solution in a microchannel by another solution", Research Disclosure, June 2001, pages 1046-1047;
- John M. Waldvogel, "Aluminum Silicon Carbide Phase Change Heat Spreader", Motorola, June 1999, Technical Developments, pages 226-230;
- James P. Slupe et al., "An idea for maintaining a stable thermal environment for electronic devices", Research Disclosure, August 2001, page 1312;
- John M. Waldvogel, "A Heat Transfer Enhancement Method for Forced Convection Bonded-Fin Heatsinks", Motorola, December 1997, Technical Developments, pages 158-159;
- "Thin Heat Pipe for Cooling Components on Printed Circuit Boards", IBM Technical Disclosure Bulletin, Vol. 34, No. 7B, December 1991, pages 321-322;
- R. C. Chu et al., "Process for Nucleate Boiling Enhancement", IBM Technical Disclosure Bulletin, Vol. 18, No. 7, December 1975, page 2227;

- J. Riseman, "Structure for Cooling by Nucleate Boiling", IBM Technical Disclosure Bulletin, Vol. 18, No. 11, April 1976, page 3700;
- "Integrally Grooved Semiconductor Chip and Heat Sink", October 1971, IBM
   Technical Disclosure Bulletin, Vol. 14, No. 5, page 1425;
- "Enhanced Cooling of Thermal Conduction Module", IBM Technical Disclosure Bulletin, Vol. 30, No. 5, October 1987, page 426;
- "Heat Exchanger Modules for Data Process with Valves Operated by Pressure form Cooling Water Pump", IBM Technical Disclosure Bulletin, Vol. 30, No. 5, October 1987, page 419;
- "Cold Plate for Thermal Conduction Module with Inlet for Cooling Water Near Highest Power Chips", IBM Technical Disclosure Bulletin, Vol. 30, No. 5, October 1987, page 413;
- "Circuit Module Cooling with Coaxial Bellow Providing Inlet, Outlet and Redundant Connections to Water-Cooled Element", IBM Technical Bulletin, Vol. 30, No. 5, October 1987, pages 345-347;
- "Piping System with Valves Controlled by Processor for Heating Circuit Modules in a Selected Temperature Profile for Sealing Integrity Test Under Temperature Stress", IBM Technical Disclosure Bulletin, Vol. 30, No. 5, October 1987, page 336;
- "Cooling System for Chip Carrier on Card", IBM Technical Disclosure Bulletin, Vol. 31, No. 4, September 1988, pages 39-40;
- "Chip Cooling Device", IBM Technical Disclosure Bulletin, Vol. 30, No. 9, February 1988, pages 435-436;
- W. E. Ahearn et al., "Silicon Heat Sink Method to Control Integrated Circuit Chip Operating Temperatures", IBM Technical Disclosure Bulletin, Vol. 21, No. 8, January 1979, pages 3378-3380;
- N. P. Bailey et al., "Cooling Device for Controlled Rectifier", IBM Technical Disclosure Bulletin, Vol. 21, No. 11, April 1979, pages 4609-4610;
- W. J. Kleinfelder et al., "Liquid-Filled Bellows Heat Sink", IBM Technical Disclosure Bulletin, Vol. 21, No. 10, March 1979, pages 4125-4126;
- R. P. Chrisfield et al., "Distributed Power/Thermal Control", IBM Technical Disclosure Bulletin, Vol. 22, No. 3, August 1979, pages 1131-1132;

- A. J. Arnold et al., "Heat Sink Design for Cooling Modules in a Forced Air Environment", IBM Technical Disclosure Bulletin, Vol. 22, No. 6, November 1979, pages 2297-2298;
- A. J. Arnold, "Structure for the Removal of Heat from an Integrated Circuit Module", IBM Technical Disclosure Bulletin, Vol. 22, No. 6, November 1979, pages 2294-2296;
- U. P. Hwang et al., "Cold Plate for Thermal Conduction Module with Improved Flow Pattern and Flexible Base", IBM Technical Disclosure Bulletin, Vol. 25, No. 9, February 1983, page 4517;
- K. C. Gallagher et al., "Cooling System for Data Processor with Flow Restricter in Secondary Loop to Limit Bypass-Cooling Water Flow", IBM Technical Disclosure Bulletin, Vol. 26, No. 5, October 1983, page 2658;
- R. C. Chu et al., "Silicon Heat Sink for Semiconductor Chip", IBM Technical Disclosure Bulletin, Vol. 24, No. 11A, April 1982, page 5743;
- J. M. Eldridge et al., "Heat-Pipe Vapor Cooling Etched Silicon Structure",
   IBM Technical Disclosure Bulletin, Vol. 25, No. 8, January 1983, pages 4118-4119;
- J. R. Skobern, "Thermoelectrically Cooled Module", IBM Technical Disclose Bulletin, Vol. 27, No. 1A, June 1984, page 30;
- M. J. Brady et al., "Etched Silicon Integrated Circuit Heat Sink", IBM
   Technical Disclosure Bulletin, Vol. 27, No. 1B, June 1984, page 627;
- H. D. Edmonds et al., "Heat Exchange Element for Semiconductor Device Cooling", IBM Technical Disclosure Bulletin, Vol. 23, No. 3, August 1980, page 1057;
- R. W. Noth, "Heat Transfer from Silicon Chips and Wafers", IBM Technical Disclosure Bulletin, Vol. 17, No. 12, May 1975, page 3544;
- "Forced Boiling Cooling System with Jet Enhancement for Crititical Heat Flux Extension", IBM Technical Disclosure Bulletin, Vol.39, No. 10, October 1996, page 143;
- "Miniature Heat Exchanger for Corrosive Media", IBM Technical Disclosure Bulletin, Vol. 38, No. 01, January 1995, pages 55-56;

- "Self-Contained Active Heat Dissipation Device", IBM Technical Disclosure Bulletin Vol. 39, No. 04, April 1996, pages 115-116;
- C. J. Keller et al., "Jet Cooling Cup for Cooling Semiconductor Devices",
   IBM Technical Disclosure Bulletin, Vol. 20, No. 9, February 1978, pages 3575-3576;
- B. J. Ronkese, "Centerless Ceramic Package with Directly Connected Heat Sink", IBM Technical Disclosure Bulletin, Vol. 20, No. 9, February 1978, page 3577-3578;
- K. S. Sachar, "Liquid Jet Cooling of Integrated Circuit Chips", Vol. 20, No. 9, February 1978, pages 3727-3728;
- A. H. Johnson, "Device Cooling", IBM Technical Disclosure Bulletin, Vol. 20, No. 10, March 1978, pages 3919-3920;
- A. L. Pacuzzo et al., "Integrated Circuit Module Package Cooling Structure", IBM Technical Disclosure Bulletin, Vol. 20, No. 10, March 1978, pages 3898-3899;
- R. D. Durand et al., "Flexible Thermal Conductor for Electronic Module",
   IBM Technical Disclosure Bulletin, Vol. 20, No. 11A, April 1978, page 4343;
- D. Balderes et al., "Liquid Cooling of a Multichip Module Package", IBM Technical Disclosure Bulletin, Vol. 20, No. 11A, April 1978, pages 4336-4337;
- J. A. Dorler et al., "Temperature Triggerable Fluid Coupling System for cooling Semiconductor Dies", IBM Technical Disclosure Bulletin, Vol. 20, No. 11A, April 1978, pages 4386-4388;
- V. W. Antonetti et al., "Integrated Module Heat Exchanger", IBM Technical Disclosure Bulletin, Vol. 20, No. 11A, April 1978, page 4498;
- P. Hwang et al., "Conduction Cooling Module", IBM Technical Disclosure Bulletin, Vol. 20, No. 11A, April 1978, pages 4334-4335;
- A. J. Arnold, "Electronic Packaging Structure", IBM Technical Disclosure Bulletin, Vol. 20, No. 11B, April 1978, pages 4820-4822;
- V. Y. Doo et al., "High Performance Package for Memory", IBM Technical Disclosure Bulletin, Vol. 21, No. 2, July 1978, pages 585-586;
- "Multi-Chip Package with Cooling by a Spreader Plate in Contact with a Chip having Cylindrical Holes Mating with an Inverse Frame Providing Water

- Flow Within its Pins", IBM Technical Disclosure Bulletin, Vol. 31, No. 5, October 1988, pages 141-142;
- J. Landrock et al., "Cooling System for Semiconductor Chips", IBM
   Technical Disclosure Bulletin, Vol. 23, No. 4, September 1980, page 1483;
- E. P. Damm, Jr., "Convection Cooling Apparatus", IBM Technical Disclosure Bulletin, Vol. 20, No. 7, December 1977, pages 2755-2756;
- "Circuit Package with Circulating Boiling Liquid and Local Heat Exchanger to Limit Vapor in Coolant Outlet", IBM Technical Disclosure Bulletin, Vol. 31, No. 12 May 1989, page 34;
- "Circuit Module Cooling with Multiple Pistons Contacting a Heat Spreader/Electrical Buffer Plate in Contact with Chip", IBM Technical Disclosure Bulletin, Vol. 31, No. 12, May 1989, page 5-7;
- "TCM-LIKE Circuit Module with Local Heat Sink Resting on Chip and Chip Separated From Coolant by Bellows with Pins and Deflector Plate Attached to Local Heat Sink and Extending Above Bellows into Region of Coolant Flow", IBM Technical Disclosure Bulletin, Vol. 31, No. 11, pages 305-306;
- "Water-Cooled Circuit Module with Grooves Forming Water Passages Near Heat-Producing Devices", IBM Technical Disclosure Bulletin, Vol. 31, No. 12, May 1989, pages 49-50;
- "Cold Plate for Thermal conduction Module with Only Peripheral Mounting bolts, Large Surface Area Fin Inserts and Reduced Water Flow and Thermal Resistances", IBM Technical Disclosure Bulletin, Vol. 31, No. 12, May 1989, page 59;
- "Thermal Control Hardware for Accelerated Run-In Testing of Multi-Chip Modules", IBM Technical Disclosure Bulletin, Vol. 32, No. 5A, October 1989, page 129-130;
- "Means of Removing More Heat From a TCM (Or Other Liquid-Cooled Logic Package) By Reducing the Coolant Temperature", IBM Technical Disclosure Bulletin, Vol. 32 No. 5A, Oct 1989, pages 153-154;
- E. G. Loeffel et al., "Liquid Cooled Module with Compliant Membrane", IBM Technical Disclosure Bulletin, Vol. 20, No. 2, July 1977, pages 673-674;

- V. Y. Doo et al., "Method of Effective Cooling of a High Power Silicon Chip", IBM Technical Disclosure Bulletin, Vol. 20, No. 4, September 1977, page 1436-1437;
- V. Y. Doo et al., "Semiconductor Chip Cooling Package, IBM Technical Disclosure Bulletin, Vol. 20, No. 4, September 1977, pages 1440-1441;
- "Heat Sink Fabrication Method", IBM Technical Disclosre Bulletin, Vol. 27,
   No. 10A, March 1985, page 5656-5657;
- "Thermal Conduction Module with Liquid Dielectric and Pistons with Surface Treatment for Enhanced Nucleate Boiling", IBM Technical Disclosure Bulletin, Vol. 27, No. 12, May 1985, page 6904;
- "Pin Fin Array Heat Pipe Apparatus", IBM Technical Disclosure Bulletin,
   Vol. 37, No. 09, September 1994, page 171;
- Youngcheol Joo et al., "Fabrication of Monolithic Microchannels for IC Chip Cooling", 1995, IEEE Micro Electro Mechanical Systems, pages 362-367;
- Jaisree Moorthy et al., <u>Active control of electroosmotic flow in microchannels using light</u>, January 26, 2001, Sensors and Actuators B 75, pages 223-229;
- Andreas Manz et al., <u>Electroosmotic pumping and electrophoretic separations</u>
   <u>for miniaturized chemical analysis systems</u>, September 16, 1994,
   J.Micromech. Microeng. 4 (1994), pages257-265, printed in the U.K;
- E. B. Cummings et al., <u>Irrotationality of uniform electroosmosis</u>, September 1999, Part of the SPIE Conference on Microfluidic Devices and Systems II, SPIE Vol. 3877, pages 180-189;
- Stephen C. Jacobson et al., <u>Fused Quartz Substrates for Microchip</u>
  <u>Electrophoresis</u>, July 1, 1995, Analytical Chemistry, Vol. 67, No. 13, pages 2059-2063;
- Haim H. Bau, <u>Optimization of conduits' shape in micro heat exchangers</u>,
   December 10, 1997, International Journal of Heat and Mass Transfer 41 (1998), pages 2717-2723;
- V. K. Dwivedi et al., <u>Fabrication of very smooth walls and bottoms of silicon microchannels for heat dissipation of semiconductor devices</u>, January 25, 2000, Microelectronics Journal 31 (2000), pages 405-410;

- M. B. Bowers et al., <u>Two-Phase Electronic Cooling Using Mini-Channel and Micro-Channel Heat Sinks: Part 2-Flow Rate and Pressure Drop Constraints</u>,
   December 1994, Journal of Electronic Packaging 116, pages 298-305;
- Meint J. de Boer et al., <u>Micromachining of Buried Micro Channels in Silicon</u>, March 2000, Journal of Microelectromechanical systems, Vol. 9, No. 1, pages 94-103;
- S.B. Choi et al., <u>FLUID FLOW AND HEAT TRANSFER IN</u>
   <u>MICROTUBES</u>, 1991, DSC-vol. 32, Micromechanical sensors, Actuators, and Systems, ASME 1991, pages 123-134;
- S. F. Choquette, M. Faghri et al., <u>OPTIMUM DESIGN OF</u>
   <u>MICROCHANNEL HEAT SINKS</u>, 1996, DSC-Vol. 59;
   Microelectromechanical Systems (MEMS), ASME 1996, pages 115-126;
- David Copeland et al., <u>MANIFOLD MICROCHANNEL HEAT SINKS</u>: <u>THEORY AND EXPERIMENT</u>, 1995, EEP-Vol. 10-2, Advances in Electronic Packaging ASME 1995, pages 829-835;
- J. M. Cuta et al., <u>FORCED CONVECTION HEAT TRANSFER IN</u>
   <u>PARALLEL CHANNEL ARRAY MICROCHANNEL HEAT</u>

   <u>EXCHANGER</u>, 1996, PID-Vol. 2 / HTD-Vol. 338, Advances in Energy efficiency, Heat/Mass Transfer Enhancement, ASME 1996, pages 17-23;
- K. Fushinobu et al., <u>HEAT GENERATION AND TRANSPORT IN SUB-MICRON SEMICONDUCTOR DEVICES</u>, 1993, HTD-Vol. 253, Heat Transfer on the Microscale, ASME 1993, pages 21-28;
- Charlotte Gillot et al., <u>Integrated Micro Heat Sink for Power Multichip</u>
   <u>Module</u>, September 3, 1999, IEEE Transactions on Industry Applications,
   Vol. 36. NO. 1. January/February 2000, pages217-221;
- John Gooding, Microchannel heat exchangers a review, SPIE Vol. 1997 High Heat Flux Engineering II (1993), pages 66-82;
- Koichiro Kawano et al., <u>Micro Channel Heat Exhanger for Cooling Electrical Equipment</u>, HTD-Vol. 361-3/PID-Vol. 3, Proceeding of the ASME Heat Transfer Division Volume 3, ASME 1998, pages 173-188;
- Chad Harris et al., <u>Design and Fabrication of a Cross Flow Micro Heat</u>
   <u>Exchanger</u>, December 2000, Journal of Microelectromechanical Systems,
   Vol. 9, No. 4, pages 502-508;

George M. Harpole et al., <u>MICRO-CHANNEL HEAT EXCHANGER</u>
 <u>OPTIMIZATION</u>, 1991, Seventh IEEE SEMI-THERM Symposium, pages59-63;

- Pei-Xue Jiang et al., <u>Thermal-hydraulic performance of small scale micro-channel and prous-media heat-exchangers</u>, 2001, International Journal of Heat and Mass Transfer 44 (2001), pages 1039-1051;
- X.N. Jiang et al., <u>Laminar Flow Through Microchannels Used for Microscale</u>
   <u>Cooling Systems</u>, 1997, IEEE/CPMT Electronic Packaging Technology
   Conference, pages 119-122, Singapore;
- David Bazeley Tuckerman, <u>Heat-Transfer Microstructures for Integrated</u>
   <u>Circuits</u>, February 1984, pages ii-xix, pages 1-141;
- M Esashi, <u>Silicon micromachining for integrated microsystems</u>, 1996,
   Vacuum/volume 47/numbers 6-8/pages 469-474;
- T.S. Raviguruajan et al., <u>Effects of Heat Flux on Two-Phase Flow</u>
   <u>characteristics of Refrigerant Flows in a Micro-Channel Heat Exchanger</u>,

   HTD-Vol. 329, National Heat Transfer Conference, Volume 7, ASME 1996,
   pages 167-178;
- T.S. Ravigruruajan et al., <u>Single-Phase Flow Thermal Performance</u>
   <u>Characteristics of a Parallel Micro-Channel Heat Exchanger</u>, 1996, HTD-Vol.

   329, National Heat Transfer Conference, Volume 7, ASME 1996, pages 157-166;
- T.S. Ravigururajan et al., <u>Liquid Flow Characteristics in a Diamond-Pattern Micro-Heat-Exchanger</u>, DSC-Vol. 59 Microelectromechanical Systems (IMEMS), ASME 1996, pages 159-166;
- T.S. Raviguruajan, <u>Impact of Channel Geometry on Two-Phase Flow Heat</u>
   <u>Transfer Characteristics of Refrigerants in Microchannel Heat Exchangers</u>,

   May 1998, Journal of Heat Transfer, Vol. 120, pages 485-491;
- J. Pfahler et al., <u>Liquid Transport in Micron and Submicron Channels</u>, March 1990, Sensors and Actuators, A21-A23 (1990), pages 431-434;
- Kenneth Pettigrew et al., <u>Performance of a MEMS based Micro Capillary</u>

  <u>Pumped Loop for Chip-Level Temperature Control</u>, 2001, The 14<sup>th</sup> IEEE

  International Conference on Micro Electro Mechanical Systems, pages 427-430;

- C. Perret et al., <u>Microchannel integrated heat sinks in silicon technology</u>, October 12-15, 1998, The 1998 IEEE Industry Applications Conference, pages 1051-1055;
- X.F. Peng et al., Convective heat transfer and flow friction for water flow in microchannel structures, 1996, Int. J. Heat Mass Transfer, Vol. 39, No. 12, pages 2599-2608, printed in Great Britain;
- X.F. Peng et al., Experimental investigation of heat transfer in flat plates with rectangular microchannels, 1994, Int. J. Heat Mass Transfer, Vol. 38, No. 1, pages 127-137, printed in Great Britain;
- X.F. Peng et al., <u>Cooling Characteristics with Microchanneled Structures</u>, 1994, Enhanced Heat Transfer, Vol. 1, No. 4, pages 315-326, printed in the United States of America;
- Yoichi Murakami et al., <u>Parametric Optimization of Multichananneled Heat</u>
   <u>Sinks for VLSI Chip Cooling</u>, March 2002, IEEE Transaction on Components and Packaging Technologies, Vol. 24, No. 1, pages 2-9;
- D. Mundinger et al., <u>High average power 2-D laser diode arrays or silicon</u> microchannel coolers, CLEO '89/Friday Morning/404;
- L.J. Missaggia et al., <u>Microchannel Heat Sinks for Two-Dimensional High-Power-Density Diode Laser Arrays</u>, 1989, IEEE Journal of Quantum Electronics, Vol. 25, No. 9, September 1989, pages 1989-1992;
- M.J. Marongiu et al., <u>Enhancement of Multichip Modules (MCMs) Cooling</u>
   <u>by Incorporating MicroHeatPipes and Other High Thermal Conductivity</u>
   <u>Materials into Microchannel Heat Sinks</u>, 1998, Electronic Components and
   Technology Conference, pages 45-50;
- C.R. Friedrich et al., <u>Micro heat exchangers fabricated by diamond</u> machining, January 1994, Precision Engineering, Vol. 16, No. 1, pages56-59;
- Mali Mahalingam, <u>Thermal Management in Semiconductor Device</u>
   <u>Packaging</u>, 1985, Proceedings of the IEEE, Vol. 73, No. 9, September 1985, pages 1396-1404;
- T.M. Adams et al., An experimental investigation of single-phase forced convection in microchannels, 1997, Int. J. Heat Mass Transfer, Vol. 41, Nos. 6-7, pages 851-857, Printed in Great Britain;

- T.M. Adams et al., <u>Applicability of traditional turbulent single-phase forced convection correlations to non-circular micrhchannels</u>, 1999, Int. J. Heat and Transfer 42 (1999) pages 4411-4415;
- Bassam Badran et al., <u>Experimental Results for Low-Temperature Silicon</u>
   <u>Micromachined Micro Heat Pipe Arrays Using Water and Methanol as</u>
   <u>Working Fluids</u>, May 31, 1997, Experimental Heat Transfer, 10: pages 253-272;
- D. Jed Harrison et al., <u>Electroosmotic Pumping Within A Chemical Sensor</u>
   <u>System Integrated on Silicon</u>, Session C9 Chemical Sensors and Systems for Liquids, June 26, 1991, pages 792-795;
- Kurt Seller et al., <u>Electroosmotic Pumping and Valveless Control of Fluid Flow within a Manifold of Capillaries on a Glass Chip</u>, 1994, Analytical Chemistry, Vol. 66, No. 20, October 15, 1994, pages 3485-3491;
- Philip H. Paul et al., <u>Electrokinetic Generation of High Pressures Using</u>
   <u>Porous Microstructures</u>, 1998, Micro-Total Analysis Systems, pages 49-52;
- Gh. Mohiuddin Mala et al., Flow characteristics of water through a microchannel between two parallel plates with electrokinetic effects, 1997, Int. J. Heat and Fluid Flow, Vol. 18, No. 5, pages489-496;
- W.E. Morf et al., <u>Partial electroosmotic pumping in complex capillary systems</u>

  <u>Part 1: Principles and general theoretical approach</u>, October 16, 2000, Sensors and Actuators B 72 (2001), pages 266-272;
- M. Esashi, <u>Silicon micromachining and micromachines</u>, September 1, 1993,
   Wear, Vol. 168, No. 1-2, (1993), pages 181-187;
- Stephanus Buttgenbach et al., <u>Microflow devices for miniaturized chemical analysis systems</u>, November 4-5, 1998, SPIE-Chemical Microsensors and Applications, Vol. 3539, pages 51-61;
- Sarah Arunlanandam et al., <u>Liquid transport in rectangular microchannels by</u>
   electroosmotic pumping, 2000, Colloids and Surfaces A: Physicochemical and
   Engineering Aspects Vol. 161 (2000), pages 89-102;
- Linan Jiang et al., <u>Closed-Loop Electroosmotic Microchannel Cooling System</u> for VLSI Circuits, Mechanical Engineering Dept. Stanford University, pages 1-27;

• Susan L. R. Barker et al., <u>Fabrication</u>, <u>Derivatization and Applications of Plastic Microfluidic Devices</u>, Proceedings of SPIE, Vol. 4205. November 5-8, 2000, pages 112-118;

- Timothy E. McKnight et al., <u>Electroosmotically Induced Hydraulic Pumping</u> with Integrated Electrodes on Microfluidic Devices, 2001, Anal. Chem., Vol. 73, pages 4045-4049;
- Chris Bourne, <u>Cool Chips plc RECEIVES NANOTECH</u>
   MANUFACTURING PATENT, July 31, 2002, pages 1-2;
- Frank Wagner et al., <u>Electroosmotic Flow Control in Micro Channels</u>
   <u>Produced by Scanning Excimer Laser Ablation</u>, 2000, Proceedings of SPIE
   Vol. 4088, June 14-16, 2000, pages 337-340;
- H. A. Goodman, <u>Data Processor Cooling With Connection To Maintain Flow</u>
   <u>Through Standby Pump.</u> December 1983, IBM Technical Disclosure Bulletin,
   Vol. 26, No. 7A, page 3325;
- <u>Electroerosion Micropump</u>, May 1990, IBM Technical Disclosure Bulletin,
   Vol. 32, No. 12, pages 342-343;
- Shulin Zeng et al., <u>Fabrication and Characterization of Electrokinetic Micro</u>
   <u>Pumps</u>, 2000 Inter Society Conference on Thermal Phenomena, pages 31-35;
- A. Manz et al., <u>Integrated Electoosmotic Pumps and Flow Manifolds for Total Chemical Analysis System</u>, 1991, Inter. Conf. on Solid-State Sensors and Actuators, pages 939-941;
- O. T. Guenat et al., <u>Partial electroosmotic pumping in complex capillary systems Part: 2 Fabrication and application of a micro total analysis system suited for continuous volumetric nanotitrations</u>, October 16, 2000, Sensors and Actuators B 72 (2001) pages 273-282;
- J. G. Sunderland, <u>Electrokinetic dewatering and thickening</u>. <u>I. Introduction and historical review of electrokinetic applications</u>, September 1987, Journal of Applied Electrochemistry Vol. 17, No. 5, pages 889-898;
- J. C. Rife et al., <u>Acousto- and electroosmotic microfluidic controllers</u>, 1998,
   Microfluidic Devices and Systems, Vol. 3515, pages 125-135;
- Purnendu K Dasgupta et al., <u>Electroosmosis: A Reliable Fluid Propulsion System for Flow Injection Analysis</u>, 1994, Anal. Chem., Vol. 66, No. 11, pages 1792-1798;

• Ray Beach et al., <u>Modular Microchannel Cooled Heatsinks for High Average</u>

<u>Power Laser Diode Arrays</u>, April 1992, IEEE Journal of Quantum Electronics,
Vol. 28, No. 4, pages 966-976;

- Roy W. Knight et al., <u>Optimal Thermal Design of Air cooled Forced</u>
   <u>Convection finned Heat Sinks Experimental Verification</u>, October 1992,
   IEEE Transactions on Components, Hybrids, and Manufacturing Technology,
   Vol. 15, No. 5 pages 754-760;
- Y. Zhuang et al., <u>Experimental study on local heat transfer with liquid impingement flow in two-dimensional micro-channels</u>, 1997, Int. J. Heat Mass Transfer, Vol. 40, No. 17, pages 4055-4059;
- D. Yu et al., <u>An Experimental and Theoretical Investigation of Fluid Flow and Heat Transfer in Microtube</u>, 1995, ASME / JSME Thermal Engineering Conference, Vol. 1, pages 523-530;
- Xiaoqing Yin et al., <u>Micro Heat Exchangers Consisting of Pin Arrays</u>, 1997,
   Journal of Electronic Packaging March 1997, Vol. 119, pages51-57;
- X. Yin et al., <u>Uniform Channel Micro Heat Exchangers</u>, 1997, Journal of Electronic Packaging June 1997, Vol. 119, No. 2, pages 89-94;
- Chun Yang et al., <u>Modeling forced liquid convection in rectangular</u>
  <u>microchannels with electrokinetic effect</u>, 1998, International Journal of Heat
  and Mass Transfer 41 (1998), pages 4229-4249;
- Arel Weisberg et al., <u>Analysis of microchannels for integrated cooling</u>, 1992,
   Int. J. Heat Mass Transfer, Vol. 35, No. 10, pages 2465-2473;
- Roger S. Stanley et al., <u>Two-Phase Flow in Microchannels</u>, 1997, DSE-Vol. 62/HTD-Vol. 354, MEMS, pages 143-152;
- B. X. Wang et al., <u>Experimental investigation on liquid forced-convection</u>
   <u>heat transfer through microchannels</u>, 1994, Int. J. Heat Mass Transfer, Vol. 37

   Suppl. 1, pages 73-82;
- Kambiz Vafai et al., <u>Analysis of two-layered micro-channel heat sink concept in electronic cooling</u>, 1999, Int. J. Heat Mass Transfer, 42 (1999), pages 2287-2297;
- Gokturk Tune et al., <u>Heat transfer in rectangular microchannels</u>, 2002, Int. J. Heat Mass Transfer, 45 (2002), pages 765-773;

- D. B. Tuckerman et al., <u>High-Performance Heat Sinking for VLSI</u>, 1981, IEEE Electron Device Letters, Vol. EDL-2, No. 5, pages 126-129;
- Bengt Sunden et al., <u>An Overview of Fabrication Methods and Fluid Flow and</u>
   Heat Transfer Characteristics of Micro Channels, pages 3-23;
- David S. Shen et al., <u>Micro Heat Spreader Enhance Heat Transfer in MCMs</u>,
   1995, IEEE Multi-Chip Module Conference, pages 189-194;
- S. Sasaki et al., <u>Optimal Structure for Microgrooved Cooling Fin for High-Power LSI Devices</u>, Electronic Letters, December 4, 1986, Vol 22, No. 25;
- Vijay K. Samalam, <u>Convective Heat Transfer in Microchannels</u>, September 1989, Journal of Electronic Materials, Vol. 18, No. 5, pages 611-617;
- Sanjay K. Roy et al., <u>A Very High Heat Flux Microchannel Heat Exchanger</u>
   for Cooling of Semiconductor Laser Diode Arrays, 1996, IEEE Transactions
   on components, packaging, and manufacturing technology-part B, Vol. 19,
   No. 2, pages 444-451;
- Charlotte Gillot et al., <u>Integrated Single and Two-Phase Micro Heat Sinks</u>
   <u>Under IGBT Chips</u>, IEEE Transactions on Components and Packaging
   Technology, Vol. 22 No. 3, September 1999, pages 384-389;
- X.F. Peng et al., "Enhancing the Critical Heat Flux Using Microchanneled Surfaces", Enhanced Heat Transfer, 1998, Vol. 5 pp. 165-176;
- H. Krumm "Chip Cooling", IBM Technical Disclosure Bulletin, Vol. 20, No.
   7, December 1977, pg. 2728;
- Jae-Mo Koo et al., "Modeling of Two-Phase Microchannel Heat Sinks for VLSI Chips", Mech. Eng. Depart. of Stanford University, pp. 422-426.

Attorney Docket No.: <u>COOL-01600</u>

This Information Disclosure Statement under 37 C.F.R. §§ 1.56 and 1.97 is not to be construed as a representation that a search has been made, that additional information material to the examination of this application does not exist, or that anyone or more of these citations constitutes prior art.

Respectfully submitted,

HAVERSTOCK & OWENS LLP

Dated: 4-29-04

Thomas B. Haverstock

Reg. No.: 32,571

Attorneys for Applicants

CERTIFICATE OF MAILING (37 CFR§ 1.8(a))

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the U.S. Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to the:

Commissioner for Patents, P.O. Box 1450 Alexandria, VA

HAVERSTOCK & OWENS LLE

Date: 4/29/04 By:

Sheet 1 of 7 U.S. Department of Commerce Patent and Trademark Office FORM PTO-1449 (Modified) Serial No.: 10/643,684 Attorney Docket No.: COOL-01600 INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use Several Sheets If Necessary) Applicants: Thomas W. Kenny et al. Group Art Unit: 1763 Filing Date: August 18, 2003 FOREIGN PATENTS OR PUBLISHED FOREIGN PATENT APPLICATIONS Translation 2004 MAY 0 3 Document **Publication Date** Country / Patent Office Class Subclass Number Yes No THAD! BO1D 61/42 Х 03/04/97 CN 97212126.9 H01L 21/50 X ΙP 2000-277540 10/06/00 AB OTHER DOCUMENTS (Including Author, Title, Date, Relevant Pages, Place of Publication) Stephen C. Jacobson et al., "Fused Quartz Substrates for Microchip Electrophoresis", Analytical Chemistry, Vo. 67, No. 13, July 1, 1995, pages 2059-2063. AC Kendra V. Sharp et al., "Liquid Flows in Microchannels", 2002, Vol. 6, pages 6-1 to 6-38. AD Shuchi Shoji et al., "Microflow devices and systems", J. Microcech. Microeng. 4 (1994), pages 157-171, printed in the U.K. ΑE Angela Rasmussen et al., "Fabrication Techniques to Realize CMOS-Compatible Microfluidic Microchannels", Journal of Microelectromechanical, Vo. 10, No. 2, June 2001, pages 286-297. AF H. Wang et al., "Thermal-Hydraulic Characteristic of Micro Heat Exchangers", 1991, DSC-Vol. 32, Micromechanical Sensors, Actuators, and AG Systems, pages 331-339. Gad Hetsroni et al., "Nonuniform Temperature Distribution in Electronic Devices Cooled by Flow in Parallel Microchannels", IEEE Transactions on Components and Packaging Technologies, March 2001, Vol. 24, No. 1, pages 16-23. AH X. F. Peng et al., "Heat Transfer Characteristics of Water Flowing through Microchannels", Experimental Heat Transfer An International Journal, Vol. 7, No. 4, October-December 1994, pages 265-283. ΑI Linan Jiang et al., "Forced Convection Boiling in a Microchannel Heat Sink", Journal of Microelectromechanical Systems, Vol. 10, No. 1, March 2001, pages 80-87. AJ Muhammad M. Rahman et al., "Experimental Measurements of Fluid Flow and Heat Transfer in Microchannel Cooling Passages in a Chip Substrate", 1993, EEP-Vol. 4-2, Advances in Electronic Packages, pages 685-692. ΑK X. F. Peng et al., "Forced convection and flow boiling heat transfer for liquid flowing through Microchannels", 1993, Int. J. Heat Mass Transfer, Vol. 36, No. 14, pages 3421-3427. AL Lung-Jieh Yang et al., "A Micro Fluidic System of Micro Channels with On-Site Sensors by Silicon Bulk Micromaching", September 1999, Microfluidic Devices and Systems II, Vol. 3877, pages 267-272. AM G. Mohjuddin Mala et al., "Heat transfer and fluid flow in microchannels", 1997, Int. J. Mass transfer, Vol. 40, No. 13, pages 3079-3088, AN J. M. Cuta et al., "Fabrication and Testing of Micro-Channel Heat Exchangers", SPIE Microlithography and Metrology in Micromaching, Vol. 2640, 1995, pages 152-160. AO Linan Jiang et al., "A Micro-Channel Heat Sink with Integrated Temperature Sensors for Phase Transition Study", 1999, 12th IEEE International Conference on Micro Electro Mechanical Systems, pages 159-164. AP Linan Jiang et al., "Fabrication and characterization of a microsystem for a micro-scale heat transfer study", J. Micromech. Microeng. 9 (1999) pages 422-428, printed in the U.K. AO M. B. Bowers et al., "High flux boiling in low flow rate, low pressure drop mini-channel and micro-channel heat sinks", 1994, Int. J. Heat Mass Transfer, Vol. 37, No. 2, pages 321-332. AR Yongendra Joshi, "Heat out of small packages", December 2001, Mechanical Engineer, pages 56-58. AS A. Rostami et al., "Liquid Flow and Heat Transfer in Microchannels: a Review", 2000, Heat and Technology, Vol. 18, No. 2, pages 59-68. AT Lian Zhang et al., "Measurements and Modeling of Two-Phase Flow in Microchannels with Nearly Constant Heat Flux Boundary Conditions", Journal of Microelectromechanical Systems, Vol.11, No. 1, February 2002, pages 12-19. ΑU Muhammad Mustafizur Rahman, "Measurements of Heat Transfer in Microchannel Heat Sinks", Int. Comm. Heat Mass Transfer, Vol. 27, No. 4, May 2000, pages 495-506. ΑV Issam Mudawar et al., "Enhancement of Critical Heat Flux from High Power Microelectronic Heat Sources in a Flow Channel", Journal of Electronic Packaging, September 1990, Vol. 112, pages 241-248. AW Nelson Kuan, "Experimental Evaluation of Micro Heat Exchangers Fabricated in Silicon", 1996, HTD-Vol. 331, National Heat Transfer Conference, Vol. 9, pages 131-136. AX E. W. Kreutz et al., "Simulation of micro-channel heat sinks for optoelectronic microsystems", Microelectronics Journal 31(2000) pages 787-790. ΑY J. C. Y. Koh et al., "Heat Transfer of Microstructure for Integrated Circuits", 1986, Int. Comm. Heat Mass Transfer, Vol. 13, pages 89-98. ΑZ Snezana Konecni et al., "Convection Cooling of Microelectronic Chips", 1992, InterSociety Conference on Thermal Phenomena, pages 138-144. BA

Date Considered:

EXAMINER: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Examiner:

FORM PTO-14- (Modified)	49	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No.: COOL-01600	Serial No.: 10/643,684
` ,	RMATIC	IN DISCLOSURE STATEMENT BY APPLICANT	Applicants: Thomas W. Kenny et al.	
(37 CFR § 1.98	(b))	(Use Several Sheets If Necessary)	Filing Date: August 18, 2003	Group Art Unit: 1763
· · · · · · · · · · · · · · · · · · ·	·_//	OTHER DOCUMENTS (Including Author, Title, D	ate, Relevant Pages, Place of Publication)	
	ВВ	Michael B. Kleiner et al., "High Performance Forced Air Coolin Transactions on Components, Packaging, and Manufacturing Te	g Scheme Employing Microchannel Heat Exchnology-Part A, Vol. 18, No. 4, pages 795	cchangers", 1995, IEEE -804.
	вс	Jerry K. Keska Ph. D. et al., "An Experimental Study on an Enha 26-2, Advances in Electronic Packaging, 1999, Vol. 2, pages 12		
	BD	Shung-Wen Kang et al., "The Performance Test and Analysis of Photonics, Vol. 3795, pages 259-270.		
	BE	Joseph C. Tramontana, "Semiconductor Laser Body Heat Sink", 379-381.		
	BF	Sarah Arulanandam et al., "Liquid transport in rectangular micr Physicochemical and Engineering Aspects 161 (2000), pages 81	rochannels by electroosmotic pumping", Col 9-102.	loid and Surfaces A:
	BG	Jeffery D. Barner et al., "Thermal Ink Jet Print Head Carriage will, January/February 1996, pages 33-34.		
	вн	"Autonomous displacement of a solution in a microchannel by a		
	BI	John M. Waldvogel, "Aluminum Silicon Carbide Phase Change		
	BJ	James P. Slupe et al., "An idea for maintaining a stable thermal 1312.	environment for electronic devices", Research	ch Disclosure, August 2001, page
	вк	John M. Waldvogel, "A Heat Transfer Enhancement Method for Technical Developments, pages 158-159.	Forced Convection Bonded-Fin Heatsinks"	, Motorola, December 1997,
	BL	"Thin Heat Pipe for Cooling Components on Printed Circuit Borpages 321-322.	ards", IBM Technical Disclosure Bulletin, V	7ol. 34, No. 7B, December 1991,
	ВМ	R. C. Chu et al., "Process for Nucleate Boiling Enhancement", I	BM Technical Disclosure Bulletin, Vol. 18,	No. 7, December 1975, page 2227.
	BN	J. Riseman, "Structure for Cooling by Nucleate Boiling", IBM T	Technical Disclosure Bulletin, Vol. 18, No. 1	1, April 1976, page 3700.
	во	"Integrally Grooved Semiconductor Chip and Heat Sink", Octob	per 1971, IBM Technical Disclosure Bulletir	ı, Vol. 14, No. 5, page 1425.
	BP	"Enhanced Cooling of Thermal Conduction Module", IBM Tech	nnical Disclosure Bulletin, Vol. 30, No. 5, O	ctober 1987, page 426.
	ВQ	"Heat Exchanger Modules for Data Process with Valves Operate Vol. 30, No. 5, October 1987, page 419.	ed by Pressure form Cooling Water Pump", I	IBM Technical Disclosure Bulletin,
	BR	"Cold Plate for Thermal Conduction Module with Inlet for Cool 30, No. 5, October 1987, page 413.	ing Water Near Highest Power Chips", IBM	Technical Disclosure Bulletin, Vol.
	BS	"Circuit Module Cooling with Coaxial Bellow Providing Inlet, C Bulletin, Vol. 30, No. 5, October 1987, pages 345-347.	Outlet and Redundant Connections to Water-	-Cooled Element", IBM Technical
	вт	"Piping System with Valves Controlled by Processor for Heating Under Temperature Stress", IBM Technical Disclosure Bulletin,	g Circuit Modules in a Selected Temperature, Vol. 30, No. 5, October 1987, page 336.	Profile for Sealing Integrity Test
	BU	"Cooling System for Chip Carrier on Card", IBM Technical Dis	closure Bulletin, Vol. 31, No. 4, September	1988, pages 39-40.
	BV	"Chip Cooling Device", IBM Technical Disclosure Bulletin, Vo	ıl. 30, No. 9, February 1988, pages 435-436.	
	вw	W. E. Ahearn et al., "Silicon Heat Sink Method to Control Integ Bulletin, Vol. 21, No. 8, January 1979, pages 3378-3380.	rated Circuit Chip Operating Temperatures'	', IBM Technical Disclosure
	вх	N. P. Bailey et al., "Cooling Device for Controlled Rectifier", IE 4610.		
	BY	W. J. Kleinfelder et al., "Liquid-Filled Bellows Heat Sink", IBM	I Technical Disclosure Bulletin, Vol. 21, No	. 10, March 1979, pages 4125-4126.
	BZ	R. P. Chrisfield et al., "Distributed Power/Thermal Control", IB 1132.	M Technical Disclosure Bulletin, Vol. 22, N	lo. 3, August 1979, pages 1131-
	CA	A. J. Arnold et al., "Heat Sink Design for Cooling Modules in a November 1979, pages 2297-2298.	Forced Air Environment", IBM Technical I	Disclosure Bulletin, Vol. 22, No. 6,
	СВ	A. J. Arnold, "Structure for the Removal of Heat from an Integral November 1979, pages 2294-2296.		
	СС	U. P. Hwang et al., "Cold Plate for Thermal Conduction Module Bulletin, Vol. 25, No. 9, February 1983, page 4517.		
	CD	K. C. Gallagher et al., "Cooling System for Data Processor with Technical Disclosure Bulletin, Vol. 26, No. 5, October 1983, pa		
Examiner:			Date Considered:	
EXAMINER:	Inį	tial citation considered. Draw line through citation if not in confo	ormance and not considered. Include copy of	f this form
	Wi	th next communication to applicant.		

FORM PTO-144	19	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No.: COOL-01600	Serial No.: 10/643,684
	RMATIC		Applicants: Thomas W. Kenny et al.	
(37 CFR § 1.98(	INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use Several Sheets If Necessary)  OTHER DOCUMENTS (Including Author, Tit)  CE R. C. Chu et al., "Silicon Heat Sink for Semiconductor Chipages 4118-4119.  CG J. R. Skobern, "Thermoelectrically Cooled Module", IBM Tooled H. D. Edmonds et al., "Heat Exchange Element for Semicon 1980, page 1057.  CJ R. W. Noth, "Heat Transfer from Silicon Chips and Wafers CK "Forced Boiling Cooling System with Jet Enhancement for October 1996, page 145.  CL "Miniature Heat Exchanger for Corrosive Media", IBM Tec CM "Self-Contained Active Heat Dissipation Device", IBM Tec CM "Self-Contained Active Heat Dissipation Device", IBM Tec CN CN Expect Active Heat Dissipation Device", IBM Tec CN CN Expect Active Heat Dissipation Device", IBM Tec CN CN CN Expect Active Heat Dissipation Device", IBM Tec CN CN CN Expect Active Heat Dissipation Device "BN Tec CN CN CN Expect Active Heat Dissipation Device", IBM Tec CN CN CN Expect Active Heat Dissipation Device "BN Tec CN CN CN Expect Active Heat Dissipation Device", IBM Tec CN CN CN Expect Active Heat Dissipation Device "BN Tec CN CN CN Expect Active Heat Dissipation Device", IBM Tec CN CN CN Expect Active Heat Dissipation Device "BN Tec CN CN CN Expect Active Heat Dissipation Device", IBM Tec CN CN Expect Active Heat Dissipation Device "BN Tec CN CN Expect Active Heat Dissipation Device", IBM Tec CN CN Expect Active Heat Dissipation Device "BN Tec CN CN Expect Active Heat Dissipation Device", IBM Technical Disclosure Active Heat Dissipation Device "BN Technical Disclosure Active Heat Dissipation Device "Cooling", IBM Technical Disclosure Active Heat Dissipation Device Cooling", IBM Technical Disclosure Active Heat Dissipation Device Technical Disclosure Technical Disclosure Technical Disclosure Technical Disclosure Technical Disclosure Technic		Filing Date: August 18, 2003	Group Art Unit: 1763
, , , , , , ,		OTHER DOCUMENTS (Including Author, Title, D	ate, Relevant Pages, Place of Publication)	
	CE	R. C. Chu et al., "Silicon Heat Sink for Semiconductor Chip", Il	BM Technical Disclosure Bulletin, Vol. 24,	No. 11A, April 1982, page 5743.
·	CF	J. M. Eldridge et al., "Heat-Pipe Vapor Cooling Etched Silicon Spages 4118-4119.	Structure", IBM Technical Disclosure Bullet	tin, Vol. 25, No. 8, January 1983,
	CG	J. R. Skobern, "Thermoelectrically Cooled Module", IBM Techn	nical Disclose Bulletin, Vol. 27, No. 1A, Jur	ne 1984, page 30.
	СН	M. J. Brady et al., "Etched Silicon Integrated Circuit Heat Sink"	', IBM Technical Disclosure Bulletin, Vol. 2	7, No. 1B, June 1984, page 627.
	CI	H. D. Edmonds et al., "Heat Exchange Element for Semiconduc 1980, page 1057.	tor Device Cooling", IBM Technical Disclo	sure Bulletin, Vol. 23, No. 3, August
	CJ	R. W. Noth, "Heat Transfer from Silicon Chips and Wafers", IB	M Technical Disclosure Bulletin, Vol.17, N	o. 12, May 1975, page 3544.
	СК	"Forced Boiling Cooling System with Jet Enhancement for Criti October 1996, page 143.	itical Heat Flux Extension", IBM Technical	Disclosure Bulletin, Vol.39, No. 10,
	CL	"Miniature Heat Exchanger for Corrosive Media", IBM Technic	cal Disclosure Bulletin, Vol. 38, No. 01, January	uary 1995, pages 55-56.
	СМ	"Self-Contained Active Heat Dissipation Device", IBM Technic	al Disclosure Bulletin Vol. 39, No. 04, Apri	1 1996, pages 115-116.
	CN			
	со	B. J. Ronkese, "Centerless Ceramic Package with Directly Conn. 1978, page 3577-3578.	nected Heat Sink", IBM Technical Disclosur	e Bulletin, Vol. 20, No. 9, February
	СР	K. S. Sachar, "Liquid Jet Cooling of Integrated Circuit Chips",	Vol. 20, No. 9, February 1978, pages 3727-2	3728.
	CQ	A. H. Johnson, "Device Cooling", IBM Technical Disclosure Bu	ulletin, Vol. 20, No. 10, March 1978, pages	3919-3920.
	CR	A. L. Pacuzzo et al., "Integrated Circuit Module Package Cooling	ng Structure", IBM Technical Disclosure Bu	lletin, Vol. 20, No. 10, March 1978,
	cs	R. D. Durand et al., "Flexible Thermal Conductor for Electronic page 4343.	Module", IBM Technical Disclosure Bullet	in, Vol. 20, No. 11A, April 1978,
	СТ	D. Balderes et al., "Liquid Cooling of a Multichip Module Pack 4336-4337.	kage", IBM Technical Disclosure Bulletin, \	/ol. 20, No. 11A, April 1978, pages
	CU	J. A. Dorler et al., "Temperature Triggerable Fluid Coupling Sys 20, No. 11A, April 1978, pages 4386-4388.	stem for cooling Semiconductor Dies", IBM	Technical Disclosure Bulletin, Vol.
	CV	V. W. Antonetti et al., "Integrated Module Heat Exchanger", IB		
	CW_	P. Hwang et al., "Conduction Cooling Module", IBM Technical	Disclosure Bulletin, Vol. 20, No. 11A, Apr	il 1978, pages 4334-4335.
	CX	A. J. Arnold, "Electronic Packaging Structure", IBM Technical	Disclosure Bulletin, Vol. 20, No. 11B, Apri	1 1978, pages 4820-4822.
	CY	V. Y. Doo et al., "High Performance Package for Memory", IBN	M Technical Disclosure Bulletin, Vol. 21, N	o. 2, July 1978, pages 585-586.
	CZ	"Multi-Chip Package with Cooling by a Spreader Plate in Conta Providing Water Flow Within its Pins", IBM Technical Disclosi	act with a Chip having Cylindrical Holes Ma ure Bulletin, Vol. 31, No. 5, October 1988, p	ating with an Inverse Frame pages 141-142.
	DA	J. Landrock et al., "Cooling System for Semiconductor Chips",	IBM Technical Disclosure Bulletin, Vol. 23	, No. 4, September 1980, page 1483.
	DB	E. P. Damm, Jr., "Convection Cooling Apparatus", IBM Techni	ical Disclosure Bulletin, Vol. 20, No. 7, Dec	ember 1977, pages 2755-2756.
	DC	"Circuit Package with Circulating Boiling Liquid and Local He. Bulletin, Vol. 31, No. 12 May 1989, page 34.	at Exchanger to Limit Vapor in Coolant Out	let", IBM Technical Disclosure
	DD	"Circuit Module Cooling with Multiple Pistons Contacting a He Disclosure Bulletin, Vol. 31, No. 12, May 1989, page 5-7.	eat Spreader/Electrical Buffer Plate in Conta	ct with Chip", IBM Technical
	DE	"TCM-LIKE Circuit Module with Local Heat Sink Resting on C Attached to Local Heat Sink and Extending Above Bellows into pages 305-306.		
	DF	"Water-Cooled Circuit Module with Grooves Forming Water Pa 31, No. 12, May 1989, pages 49-50.	assages Near Heat-Producing Devices", IBM	Technical Disclosure Bulletin, Vol.
	DG	"Cold Plate for Thermal conduction Module with Only Peripher Thermal Resistances", IBM Technical Disclosure Bulletin, Vol.	ral Mounting bolts, Large Surface Area Fin 31, No. 12, May 1989, page 59.	inserts and Reduced Water Flow and
Examiner:			Date Considered:	
EXAMINER:	Ini wi	tial citation considered. Draw line through citation if not in confeth next communication to applicant.	ormance and not considered. Include copy o	f this form

Sheet 4 of 7

FORM PTO-1449 (Modified)	9	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No.: COOL-01600	Serial No.: 10/643,684
` ,	MATIO	ON DISCLOSURE STATEMENT BY APPLICANT (Use Several Sheets If Necessary)	Applicants: Thomas W. Kenny et al.	
(37 CFR § 1.98(b	o))	(Use Several Silices if Accessary)	Filing Date: August 18, 2003	Group Art Unit: 1763
	· · ·	OTHER DOCUMENTS (Including Author, Title, D	ate, Relevant Pages, Place of Publication)	
	DH	"Thermal Control Hardware for Accelerated Run-In Testing of N October 1989, page 129-130.	Multi-Chip Modules", IBM Technical Disclo	sure Bulletin, Vol. 32, No. 5A,
	DI	"Means of Removing More Heat From a TCM (Or Other Liquid Technical Disclosure Bulletin, Vol. 32 No. 5A, Oct 1989, pages	-Cooled Logic Package) By Reducing the C 153-154.	oolant Temperature", IBM
	DJ	E. G. Loeffel et al., "Liquid Cooled Module with Compliant Med 673-674.	mbrane", IBM Technical Disclosure Bulletin	n, Vol. 20, No. 2, July 1977, pages
	DK	V. Y. Doo et al., "Method of Effective Cooling of a High Power 1977, page 1436-1437.	Silicon Chip", IBM Technical Disclosure B	sulletin, Vol. 20, No. 4, September
	DL	V. Y. Doo et al., "Semiconductor Chip Cooling Package, IBM T 1441.	echnical Disclosure Bulletin, Vol. 20, No. 4	, September 1977, pages 1440-
	DM	"Heat Sink Fabrication Method", IBM Technical Disclosre Bulle	etin, Vol. 27, No. 10A, March 1985, page 5	656-5657.
	DN	"Thermal Conduction Module with Liquid Dielectric and Piston Disclosure Bulletin, Vol. 27, No. 12, May 1985, page 6904.	s with Surface Treatment for Enhanced Nuc	leate Boiling", IBM Technical
	DO	"Pin Fin Array Heat Pipe Apparatus", IBM Technical Disclosure		
	DP	Youngcheol Joo et al., "Fabrication of Monolithic Microchannel 362-367.	s for IC Chip Cooling", 1995, IEEE Micro	Electro Mechanical Systems, pages
	DQ	Jaisree Moorthy et al., Active control of electroosmotic flow in r 223-229.	nicrochannels using light, January 26, 2001,	Sensors and Actuators B 75, pages
	DR	Andreas Manz et al., Electroosmotic pumping and electrophoret J.Micromech. Microeng. 4 (1994), pages257-265, printed in the	ic separations for miniaturized chemical and U.K.	llysis systems, September 16, 1994,
	DS	E. B. Cummings et al., <u>Irrotationality of uniform electroosmosis</u> . Systems II, SPIE Vol. 3877, pages 180-189	September 1999, Part of the SPIE Conferen	nce on Microfluidic Devices and
	DT	Stephen C. Jacobson et al., <u>Fused Quartz Substrates for Microch</u> 2059-2063.	ip Electrophoresis, July 1, 1995, Analytical	Chemistry, Vol. 67, No. 13, pages
	DU	Haim H. Bau, Optimization of conduits' shape in micro heat exc 41 (1998), pages 2717-2723.	changers, December 10, 1997, International	Journal of Heat and Mass Transfer
	DV	V. K. Dwivedi et al., Fabrication of very smooth walls and botto January 25, 2000, Microelectronics Journal 31 (2000), pages 40	ms of silicon microchannels for heat dissipa 5-410.	tion of semiconductor devices,
	DW	M. B. Bowers et al., Two-Phase Electronic Cooling Using Mini Constraints, December 1994, Journal of Electronic Packaging T	-Channel and Micro-Channel Heat Sinks: Police, pages 298-305.	art 2-Flow Rate and Pressure Drop
	DX	Meint J. de Boer et al., Micromachining of Buried Micro Chann No. 1, pages 94-103.	els in Silicon, March 2000, Journal of Micro	pelectromechanical systems, Vol. 9,
	DY	S.B. Choi et al., FLUID FLOW AND HEAT TRANSFER IN MI Systems, ASME 1991, pages 123-134.	CROTUBES, 1991, DSC-vol. 32, Microme	chanical sensors, Actuators, and
	DZ	S. F. Choquette, M. Faghri et al., <u>OPTIMUM DESIGN OF MIC</u> Systems (MEMS), ASME 1996, pages 115-126.		
	EA	David Copeland et al., MANIFOLD MICROCHANNEL HEAT Electronic Packaging ASME 1995, pages 829-835.	SINKS: THEORY AND EXPERIMENT, 19	995, EEP-Vol. 10-2, Advances in
	ЕВ	J. M. Cuta et al., FORCED CONVECTION HEAT TRANSFER EXCHANGER, 1996, PID-Vol. 27 HTD-Vol. 338, Advances in	IN PARALLEL CHANNEL ARRAY MICE Energy efficiency, Heat/Mass Transfer Enh	ROCHANNEL HEAT ancement, ASME 1996, pages 17-23
	EC	K. Fushinobu et al., HEAT GENERATION AND TRANSPORT Heat Transfer on the Microscale, ASME 1993, pages 21-28.	IN SUB-MICRON SEMICONDUCTOR D	EVICES, 1993, HTD-Vol. 253,
	ED	Charlotte Gillot et al., Integrated Micro Heat Sink for Power Mu Applications, Vol. 36. NO. 1. January/February 2000, pages217	ltichip Module, September 3, 1999, IEEE T	ransactions on Industry
	EE	John Gooding, Microchannel heat exchangers - a review, SPIE V	ol. 1997 High Heat Flux Engineering II (19	93), pages 66-82.
	EF	Koichiro Kawano et al., Micro Channel Heat Exhanger for Cool ASME Heat Transfer Division - Volume 3, ASME 1998, pages I	ing Electrical Equipment, HTD-Vol. 361-3/. 73-188.	PID-Vol. 3, Proceeding of the
	EG	Chad Harris et al., Design and Fabrication of a Cross Flow Micr Systems, Vol. 9, No. 4, pages 502-508.		
Examiner:			Date Considered:	
EXAMINER:		tial citation considered. Draw line through citation if not in conformation to applicant.	rmance and not considered. Include copy of	this form

Sheet 5 of 7

FORM PTO-1449	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No.: COOL-01600	Serial No.: 10/643,684
(Modified)  INFORMATION	ON DISCLOSURE STATEMENT BY APPLICANT	Applicants: Thomas W. Kenny et al.	
(37 CFR § 1.98(b))	(Use Several Sheets If Necessary)	Filing Date: August 18, 2003	Group Art Unit: 1763
	OTHER DOCUMENTS (Including Author, Title, D	ate, Relevant Pages, Place of Publication)	
ЕН	George M. Harpole et al., MICRO-CHANNEL HEAT EXCHAI pages 59-63.	NGER OPTIMIZATION, 1991, Seventh IEE	E SEMI-THERM Symposium,
EI	Pei-Xue Jiang et al., Thermal-hydraulic performance of small so of Heat and Mass Transfer 44 (2001), pages 1039-1051.	ale micro-channel and prous-media heat-exc	changers, 2001, International Journal
EJ	X.N. Jiang et al., <u>Laminar Flow Through Microchannels Used fr</u> Technology Conference, pages 119-122, Singapore.	or Microscale Cooling Systems, 1997, IEEE	/CPMT Electronic Packaging
EK	David Bazeley Tuckerman, Heat-Transfer Microstructures for In	ntegrated Circuits, February 1984, pages ii-x	ix, pages 1-141.
EL	M Esashi, Silicon micromachining for integrated microsystems,		
ЕМ	T.S. Raviguruajan et al., Effects of Heat Flux on Two-Phase Flo HTD-Vol. 329, National Heat Transfer Conference, Volume 7,	ow characteristics of Refrigerant Flows in a NASME 1996, pages 167-178.	Micro-Channel Heat Exchanger,
EN	T.S. Ravigruruajan et al., Single-Phase Flow Thermal Performal Vol. 329, National Heat Transfer Conference, Volume 7, ASME	nce Characteristics of a Parallel Micro-Chan E 1996, pages 157-166	nel Heat Exchanger, 1996, HTD-
EO	T.S. Ravigururajan et al., Liquid Flow Characteristics in a Diam Systems (IMEMS), ASME 1996, pages 159-166	nond-Pattern Micro-Heat-Exchanger, DSC-V	/ol. 59 Microelectromechanical
ЕР	T.S. Raviguruajan, Impact of Channel Geometry on Two-Phase Exchangers, May 1998, Journal of Heat Transfer, Vol. 120, pag	Flow Heat Transfer Characteristics of Refriges 485-491	gerants in Microchannel Heat
EQ	J. Pfahler et al., Liquid Transport in Micron and Submicron Cha	annels, March 1990, Sensors and Actuators,	A21-A23 (1990), pages 431-434.
ER	Kenneth Pettigrew et al., Performance of a MEMS based Micro IEEE International Conference on Micro Electro Mechanical Sy	Capillary Pumped Loop for Chip-Level Terstems, pages 427-430.	mperature Control, 2001, The 14 <sup>th</sup>
ES	C. Perret et al., Microchannel integrated heat sinks in silicon tec Conference, pages 1051-1055.	chnology, October 12-15, 1998, The 1998 IF	EEE Industry Applications
ET	X.F. Peng et al., Convective heat transfer and flow friction for v. No. 12, pages 2599-2608, printed in Great Britain.	vater flow in microchannel structures, 1996,	Int. J. Heat Mass Transfer, Vol. 39,
EU	X.F. Peng et al., Experimental investigation of heat transfer in f 38, No. 1, pages 127-137, printed in Great Britain.	lat plates with rectangular microchannels, 19	994, Int. J. Heat Mass Transfer, Vol.
EV	X.F. Peng et al., Cooling Characteristics with Microchanneled Sin the United States of America.	Structures, 1994, Enhanced Heat Transfer, V	ol. 1, No. 4, pages 315-326, printed
EW	Yoichi Murakami et al., Parametric Optimization of Multichana Components and Packaging Technologies, Vol. 24, No. 1, page		
EX	D. Mundinger et al., High average power 2-D laser diode arrays		
EY	L.J. Missaggia et al., Microchannel Heat Sinks for Two-Dimens Electronics, Vol. 25, No. 9, September 1989, pages 1989-1992.	sional High-Power-Density Diode Laser Arra	ays, 1989, IEEE Journal of Quantum
EZ	M.J. Marongiu et al., Enhancement of Multichip Modules (MC Conductivity Materials into Microchannel Heat Sinks, 1998, El	Ms) Cooling by Incorporating MicroHeatPip ectronic Components and Technology Conto	oes and Other High Thermal erence, pages 45-50
FA	C.R. Friedrich et al., Micro heat exchangers fabricated by diam		
FB	Mali Mahalingam, Thermal Management in Semiconductor Depages 1396-1404.	vice Packaging, 1985, Proceedings of the IE	EE, Vol. 73, No. 9, September 1985,
FC	T.M. Adams et al., An experimental investigation of single-pha.	se forced convection in microchannels, 1997	7, Int. J. Heat Mass Transfer, Vol. 41,
FD	T.M. Adams et al., Applicability of traditional turbulent single- Heat and Transfer 42 (1999) pages 4411-4415.	phase forced convection correlations to non-	circular micrhchannels, 1999, Int. J.
FE	Bassam Badran et al., Experimental Results for Low-Temperature as Working Fluids, May 31, 1997, Experimental Heat Transfer,	ure Silicon Micromachined Micro Heat Pipe 10: pages 253-272.	Arrays Using Water and Methanol
FF	D. Jed Harrison et al., Electroosmotic Pumping Within A Chem Systems for Liquids, June 26, 1991, pages 792-795.		ession C9 Chemical Sensors and
FG	Kurt Seller et al., Electroosmotic Pumping and Valveless Contr Analytical Chemistry, Vol. 66, No. 20, October 15, 1994, pages		
FH	Philip H. Paul et al., Electrokinetic Generation of High Pressure 52.		
Fi	Gh. Mohiuddin Mala et al., Flow characteristics of water through Int. J. Heat and Fluid Flow, Vol. 18, No. 5, pages489-496	gh a microchannel between two parallel plate	es with electrokinetic effects, 1997,
Examiner:		Date Considered:	
EXAMINER: In	nitial citation considered. Draw line through citation if not in conferth next communication to applicant.	ormance and not considered. Include copy o	f this form

FORM PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No.: COOL-01600	Serial No.: 10/643,684
` ′	TION DISCLOSURE STATEMENT BY APPLICANT	Applicants: Thomas W. Kenny et al.	
(37 CFR § 1.98(b))	(Use Several Sheets If Necessary)	Filing Date: August 18, 2003	Group Art Unit: 1763
	OTHER DOCUMENTS (Including Author, Title, D	ate, Relevant Pages, Place of Publication)	
FJ	W.E. Morf et al., Partial electroosmotic pumping in complex car 2000, Sensors and Actuators B 72 (2001), pages 266-272.	oillary systems Part 1: Principles and genera	1 theoretical approach, October 16,
FK	M. Esashi, Silicon micromachining and micromachines, Septem	ber 1, 1993, Wear, Vol. 168, No. 1-2, (1993)	3), pages 181-187.
FL	Stephanus Buttgenbach et al., Microflow devices for miniaturize Microsensors and Applications, Vol. 3539, pages 51-61.	ed chemical analysis systems, November 4-5	i, 1998, SPIE-Chemical
FM	Sarah Arunlanandam et al., Liquid transport in rectangular micro Physicochemical and Engineering Aspects Vol. 161 (2000), pag	ochannels by electroosmotic pumping, 2000 es 89-102.	, Colloids and Surfaces A:
FN	Linan Jiang et al., Closed-Loop Electroosmotic Microchannel C University, pages 1-27.	ooling System for VLSI Circuits, Mechanic	al Engineering Dept. Stanford
FO	Susan L. R. Barker et al., Fabrication, Derivatization and Applic November 5-8, 2000, pages 112-118.	cations of Plastic Microfluidic Devices, Proc	reedings of SPIE, Vol. 4205.
FP	Timothy E. McKnight et al., Electroosmotically Induced Hydrau Chem., Vol. 73, pages 4045-4049.	alic Pumping with Integrated Electrodes on I	Microfluidic Devices, 2001, Anal.
FQ	Chris Bourne, Cool Chips plc RECEIVES NANOTECH MANU	JFACTURING PATENT, July 31, 2002, pag	ges 1-2.
FR	Frank Wagner et al., Electroosmotic Flow Control in Micro Cha SPIE Vol. 4088, June 14-16, 2000, pages 337-340.	nnels Produced by Scanning Excimer Laser	Ablation , 2000, Proceedings of
FS	H. A. Goodman, Data Processor Cooling With Connection To M. Disclosure Bulletin, Vol. 26, No. 7A, page 3325.	-	
FT	Electroerosion Micropump, May 1990, IBM Technical Disclosu	re Bulletin, Vol. 32, No. 12, pages 342-343	•
FU	Shulin Zeng et al., <u>Fabrication and Characterization of Electrok</u> pages 31-35.	inetic Micro Pumps, 2000 Inter Society Con	ference on Thermal Phenomena,
FV	A. Manz et al., Integrated Electoosmotic Pumps and Flow Mani Sensors and Actuators, pages 939-941.	folds for Total Chemical Analysis System, 1	991, Inter. Conf. on Solid-State
FW	O. T. Guenat et al., Partial electroosmotic pumping in complex system suited for continuous volumetric nanotitrations, October		
FX	J. G. Sunderland, Electrokinetic dewatering and thickening. I. Ir Journal of Applied Electrochemistry Vol. 17, No. 5, pages 889-	ntroduction and historical review of electrok 898.	inetic applications, September 1987,
FY	J. C. Rife et al., Acousto- and electroosmotic microfluidic contr		ems, Vol. 3515, pages 125-135.
FZ	Purnendu K Dasgupta et al., <u>Electroosmosis: A Reliable Fluid P</u> 11, pages 1792-1798.	ropulsion System for Flow Injection Analys	is, 1994, Anal. Chem., Vol. 66, No.
GA	Ray Beach et al., Modular Microchannel Cooled Heatsinks for I Electronics, Vol. 28, No. 4, pages 966-976.	High Average Power Laser Diode Arrays, A	oril 1992, IEEE Journal of Quantum
GB	Roy W. Knight et al., Optimal Thermal Design of Air cooled For IEEE Transactions on Components, Hybrids, and Manufacturin	rced Convection finned Heat Sinks - Experig Technology, Vol. 15, No. 5 pages 754-760	mental Verification, October 1992,
GC	Y. Zhuang et al., Experimental study on local heat transfer with Mass Transfer, Vol. 40, No. 17, pages 4055-4059.		
GD	D. Yu et al., An Experimental and Theoretical Investigation of I Engineering Conference, Vol. 1, pages 523-530.		
GE	Xiaoqing Yin et al., Micro Heat Exchangers Consisting of Pin A	Arrays, 1997, Journal of Electronic Packagin	g March 1997, Vol. 119, pages51-57.
GF	X. Yin et al., Uniform Channel Micro Heat Exchangers, 1997, J		
GG	Chun Yang et al., Modeling forced liquid convection in rectang and Mass Transfer 41 (1998), pages 4229-4249.	ular microchannels with electrokinetic effec	t, 1998, International Journal of Heat
GH	Arel Weisberg et al., Analysis of microchannels for integrated c		
GI	Roger S. Stanley et al., Two-Phase Flow in Microchannels, 199	7, DSE-Vol. 62/HTD-Vol. 354, MEMS, pag	es 143-152.
GJ	B. X. Wang et al., Experimental investigation on liquid forced- Vol. 37 Suppl. 1, pages 73-82.	convection heat transfer through microchant	nels, 1994, Int. J. Heat Mass Transfer,
GK	Kambiz Vafai et al., Analysis of two-layered micro-channel heapages 2287-2297.	t sink concept in electronic cooling, 1999, I	nt. J. Heat Mass Transfer, 42 (1999),
Examiner:		Date Considered:	
EXAMINER:	Initial citation considered. Draw line through citation if not in confewith next communication to applicant.	ormance and not considered. Include copy of	f this form

FORM PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket No.: COOL-01600	Serial No.: 10/643,684
1 '	ATION DISCLOSURE STATEMENT BY APPLICANT (Use Several Sheets If Necessary)	Applicants: Thomas W. Kenny et al.	<del></del> -
(37 CFR § 1.98(b))	(OSC SEVERAL SHOOLS IL PROCESSALY)	Filing Date: August 18, 2003	Group Art Unit: 1763
	OTHER DOCUMENTS (Including Author, Title,	Date, Relevant Pages, Place of Publication)	
G	Gokturk Tune et al., Heat transfer in rectangular microchanne	s, 2002, Int. J. Heat Mass Transfer, 45 (2002)	), pages 765-773.
Gi	D. B. Tuckerman et al., High-Performance Heat Sinking for V	LSI, 1981, IEEE Electron Device Letters, Vol	. EDL-2, No. 5, pages 126-129.
G	N Bengt Sunden et al., An Overview of Fabrication Methods and	Fluid Flow and Heat Transfer Characteristics	s of Micro Channels, pages 3-23.
G	David S. Shen et al., Micro Heat Spreader Enhance Heat Tran	fer in MCMs, 1995, IEEE Multi-Chip Modu	le Conference, pages189-194.
G	S. Sasaki et al., Optimal Structure for Microgrooved Cooling No. 25.	in for High-Power LSI Devices, Electronic L	etters, December 4, 1986, Vol 22,
G	Vijay K. Samalam, Convective Heat Transfer in Microchanne 617.	s, September 1989, Journal of Electronic Man	terials, Vol. 18, No. 5, pages 611-
G	Sanjay K. Roy et al., A Very High Heat Flux Microchannel He Transactions on components, packaging, and manufacturing to	at Exchanger for Cooling of Semiconductor I chnology-part B, Vol. 19, No. 2, pages 444-4	aser Diode Arrays, 1996, IEEE
G	Charlotte Gillot et al., Integrated Single and Two-Phase Micro Packaging Technology, Vol. 22 No. 3, September 1999, pages	Heat Sinks Under IGBT Chips, IEEE Transa 384-389.	ctions on Components and
G			
G	J H. Krumm "Chip Cooling", IBM Technical Disclosure Bulleti	n, Vol. 20, No. 7, December 1977, pg. 2728.	
G	Jae-Mo Koo et al., "Modeling of Two-Phase Microchannel He 426.	at Sinks for VLSI Chips", Mech. Eng. Depart	. of Stanford University, pp. 422-
G'	N		
G	x		· · · · · · · · ·
G	Y		
G	z		
Н	Α		
Н	В		
Н	c		
Н	D		
Н	E		
Н	F		
н	G		
Н	н		<u></u>
H	1		
Н	J		
Н	К		
н	L		
Н	M		
Н	N		
Н	0		
Н	P		
Н	Q		
Н	R		
Н	s		
Н	т		
Examiner:		Date Considered:	
EXAMINER:	Initial citation considered. Draw line through citation if not in cor	formance and not considered. Include copy of	f this form

# UNITED STATES PATENT AND TRADEMARK OFFICE ACKNOWLEDGEMENT RECEIPT

lectronic Version 1.1

ylesheet Version v1.1.1

Title of Invention

APPARATUS AND METHOD OF FORMING CHANNELS IN A HEAT-EXCHANGING DEVICE

Submission Type:

Information Disclosure Statement

Application Number:

10/643684

\*10/643684\*

EFS ID:

59981

Server Response:

Confirmation Code	Message
	Submission was successfully submitted – Even if Informational or Warning Messages appear below, please do not resubmit this application
ICON1	4600
ISYS5	Filename= N/A BusinessRule= Validation System/Function Call Information. #Supporting Msg:Server unable to validate the Confirmaton/Application numbers at this time. They will be checked by PTO personnel later.

First Named Applicant:

Thomas Kenny

Attorney Docket Number:

Timestamp:

2004-04-28 14:25:44 EDT

From:

us

File Listing:

Doc. Name	File Name	Size (Bytes)
us-ids	COOL01600A-usidst.xml	9134
us-ids	us-ids.dtd	7763
us-ids	us-ids.xsl	12026

file://G:\!IDS-E-Filed\COOL01600\COOL01600A\COOL01600A-xmre.xml

4/28/2004

Acknowledgement Receipt

Page 2 of 2

package-data	COOL01600A-pkda.xml	1714
package-data	package-data.dtd	27025
package-data	us-package-data.xsl	19263
	Total files size	76925

Message Digest:

f3990c46fd9f13fb76a6ff479d263f8e1d9dc6ce

Digital Certificate Holder cn=Thomas B. Haverstock,ou=Registered Attorneys,ou=Patent

Name:

and Trademark Office, ou = Department of Commerce, o = U.S.

Government, c=US

Transmittal

TRANSMITTAL

Page 2 of 2

COOL01600A-usidst.xml

Documents being submitted

us-ids

Transmittal

Page 1 of 2

us-ids.dtd us-ids.xsl

Electronic Version v1.

Stylesheet Version v1.1.0

APPARATUS AND METHOD OF FORMING CHANNELS IN A HEAT-EXCHANGING DEVICE Invention Title of

Comments

\*10/643684\* 10/643684 Application Number:

2003-08-18

Thomas Kenny First Named Applicant:

4600 Confirmation Number:

Attorney Docket Number:

or other use besides the filing of official correspondence by authorized parties between patent applicants or their representatives and the USPTO. Fraudulent I hereby certify that the use of this system is for OFFICIAL correspondence is strictly prohibited, and subject to a fine and/or imprisonment under applicable law.

application noted in the submission. This document(s) will become part of the I, the undersigned, certify that I have viewed a display of document(s) being using either the USPTO provided style sheet or software, and that this is the electronically submitted to the United States Patent and Trademark Office, document(s) I intend for initiation or further prosecution of a patent official electronic record at the USPTO.

Sign. Capacity	Attorney	
Elec. Sign.	/tbh/	
Submitted by:	Thomas B. Haverstock Registered Number: 32571	

file://G:\!IDS-E-Filed\COOL01600\COOL01600A\COOL01600A-pkda.xml

file://G:\!IDS-E-Filed\COOL01600\COOL01600A\COOL01600A-pkda.xml

ELECTRONIC INFORMATION DISCLOSURE STATEMENT Electronic Version v18 Stylesheet Version v18.0

APPARATUS AND METHOD OF FORMING CHANNELS IN Title of A HEAT-EXCHANGING DEVICE Invention

> \*10/643684\* 10/643684

Confirmation Number: 4600 First Named Applicant: Thomas Kenny

Attorney Docket Number:

Search string:

Application Number:

( 3654988 or 3817321 or 3823572 or 3923426 or 3929154 or 4109707 or 4138996 or 4194559 or 4248295 or 4312012 or 4450472 or 4485429 or 4516632 or 4540115 or 4561040 or 4567505 or 4573067 or 4664181 or 4758926 or 4866570 or 4868712 or 4894709 or 4896719 or 4908112 or 4938280 or 5009760 or 5016138 or 5057908 or 5058627 or 5070040 or 5083194 or 5088005 or 5096388 or 5099311 or 5099910 or 5125451 or 5131233 or 5203401 or 5218515 or 5219278 or 5232047 or 5239200 or 5263251 or 5274920 or 5308429 or 5309319 or 5317805 or 5325265 or 5336062 or

### **US Patent Documents**

Note: Applicant is not required to submit a paper copy of cited US Patent Documents

5380956 ).pn.

ĺ	init	Cite.No.	Patent No.	Date	Patentee	Kind	Class	Subclass
ı		1	3654988	1972-04-11	Clayton, ill			
۱		2	3817321	1974-06-18	von Cube et al.	]		
		3	3823572	1974-07-16	Cochran, Jr.	]		
		4	3923426	1975-12-02	Theeuwes	]		
۱		5	3929154	1975-12-30	Goodwin	}		
		6	4109707	1978-08-29	Wiison et al.			
		7	4138996	1979-02-13	Cartland	]		
П						1		

file://G:\!IDS-E-Filed\COOL01600\COOL01600A\COOL01600A-usidst.xml

4/28/2004

4194559 | 1980-03-25 Eastman 4248295 1981-02-03 Ernst et al. 4312012 1982-01-19 Frieser et al. 10 4450472 1984-05-22 Tuckerman et al. 1984-11-27 12 4485429 Mittal 4516632 1985-05-14 Swift et al. 1985-09-10 4540115 Hawrylo 4561040 1985-12-24 Eastman et al. 4567505 1986-01-28 Pease et al. 16 17 4573067 1986-02-25 Tuckerman et al. 1987-05-12 Sumberg 18 4664181 4758926 1988-07-19 Herrell et al. 1989-09-12 Porter 20 4866570 4868712 1989-09-19 1990-01-16 4894709 Phillips et al. 1990-01-30 O'Neill et al. 23 4896719 24 4908112 1990-03-13 Pace 4938280 1990-07-03 25 26 5009760 1991-04-23 Zare et al. 1994-05-14 5016138 27 28 5057908 1991-10-15 Weber 5058627 1991-10-22 29 Brannen 5070040 1991-12-03 Pankove Bartilson 5083194 1992-01-21 31 32 5088005 1992-02-11 Ciaccio 2002-03-17 Weinberg 33 5096388 5099311 1992-03-24 Bonde et al Walpoie et al. 1992-03-31 35 5099910 5125451 1992-01-30 Matthews 1992-07-21 5131233 37 Cray et ai. 5203401 1993-04-20 mburgen et al. 38 1993-06-08 Bernhardt 39 5218515 5219278 1993-06-15 Van Lintel 41 5232047 1993-08-03 Matthews 5239200 1993-08-24

file://G:\!IDS-E-Filed\COOL01600\COOL01600A\COOL01600A-usidst.xml

4/28/2004

Information Disclosure Statement

	43	5263251	1993-11-23	Matthews
	44	5274920	1994-01-04	Mathews
	45	5308429	1994-05-03	Bradley
	46	5309319	1994-05-03	Messina
	47	5317805	1994-06-07	Hoopman et al.
	48	5325265	1994-06-28	Turlik et al.
$\neg$	49	5336062	1994-08-09	Richter
	50	5380956	1995-01-10	Loo et al.

## Signature

Examiner Name	Date

\*10/643684\*



## UNITED STATES PATENT AND TRADEMARK OFFICE ACKNOWLEDGEMENT RECEIPT

Electronic Version 1.1 Stylesheet Version v1.1.1

> APPARATUS AND METHOD OF FORMING CHANNELS IN A HEAT-EXCHANGING DEVICE Title of Invention

Submission Type:

Information Disclosure Statement

Application Number:

10/643684

59982

Server Response:

EFS ID:

Confirmation Code	Message
ISVR1	Submission was successfully submitted – Even if Informational or Warning Messages appear below, please do not resubmit this application
ICON1	4600
ISYS5	Filename= N/A BusinessRule= Validation System/Function Call Information. #Supporting Msg:Server unable to validate the Confirmaton/Application numbers at this time. They will be checked by PTO personnel later.

First Named Applicant:

Thomas Kenny

Attorney Docket Number:

Timestamp:

2004-04-28 14:27:09 EDT

From:

us

File Listing:

Doc. Name	File Name	Size (Bytes)
us-ids	COOL016008-usidst.xml	9226
us-ids	us-ids.dtd	7763
us-ids	us-ids.xsl	12026
	<del></del>	

 $file: /\!/G: \verb|\|IDS-E-Filed| COOL01600 \verb|\|COOL01600B| COOL01600B-xmre.xml| \\$ 

4/28/2004

Acknowledgement Receipt

Page 2 of 2

package-data	COOL01600B-pkda.xml	1714
package-data	package-data.dtd	27025
package-data	us-package-data.xsl	19263
	Total files size	77017

Message Digest:

15e307a35b36b0300854725b3f269c3330aa2539

Digital Certificate Holder cn=Thomas B. Haverstock,ou=Registered Attorneys,ou=Patent and Trademark Office, ou=Department of Commerce, o=U.S.

Name:

Government,c=US

Transmittal

TRANSMITTAL

Page 2 of 2

COOL01600B-usidst.xml

Documents being submitted

us-ids

Transmittal

Page 1 of 2

us-ids.dtd us-ids.xs

Electronic Version v1.1

Stylesheet Version v1.1.0

APPARATUS AND METHOD OF FORMING CHANNELS IN A HEAT-EXCHANGING DEVICE Invention Title of

Comments

\*10/643684\* 10/643684 Application Number:

2003-08-18

Thomas Kenny First Named Applicant: Date:

4600 Confirmation Number:

Attorney Docket Number:

or other use besides the filing of official correspondence by authorized parties between patent applicants or their representatives and the USPTO. Fraudulent I hereby certify that the use of this system is for OFFICIAL correspondence is strictly prohibited, and subject to a fine and/or imprisonment under applicable law.

application noted in the submission. This document(s) will become part of the I, the undersigned, certify that I have viewed a display of document(s) being using either the USPTO provided style sheet or software, and that this is the electronically submitted to the United States Patent and Trademark Office, document(s) I intend for initiation or further prosecution of a patent official electronic record at the USPTO.

Submitted by:	Elec. Sign.	Sign. Capacity
homas B. Haverstock	/tbh/	
egistered Number: 32571		Attorney

file://G:\!IDS-E-Filed\COOL01600\COOL01600B\COOL01600B-pkda.xml

MAY 0 3 2004

& TRADEMARY

Page'l of 3

\*10/643684\*

ELECTRONIC INFORMATION DISCLOSURE STATEMENT

Electronic Version v18 Stylesheet Version v18.0

> Title of Invention

APPARATUS AND METHOD OF FORMING CHANNELS IN

A HEAT-EXCHANGING DEVICE

10/643684

4600 Confirmation Number: First Named Applicant: Thomas Kenny

Attorney Docket Number:

Application Number:

Search string:

( 5383340 or 5421943 or 5427174 or 5436793 or 5459099 or 5508234 or 5514832 or 5514906 or 5544696 or 5548605 or 5575929 or 5579828 or 5585069 or 5641400 or 5692558 or 5696405 or 5703536 or 5704416 or 5727618 or 5759014 or 5763951 or 5774779 or 5800690 or 5801442 or 5835345 or 5836750 or 5858188 or 5863708 or 5869004 or 5870823 or 5874795 or 5876655 or 5880017 or 5880524 or 5901037 or 5936192 or 5940270 or 5942093 or 5964092 or 5965001 or 5965813 or 5978220 or 5997713 or 5998240 or 6007309 or 6010316 or 6013164 or 6019882 or 6054034 or

#### **US Patent Documents**

Note: Applicant is not required to submit a paper copy of cited US Patent Documents

6068752 ).pn.

	init	Cite.No.	Patent No.	Date	Patentee	Kind	Class	Subclass
Ĭ	$\neg$	1	5383340	1995-01-24	Larson et al.			
Ì		2	5421943	1995-06-06	Tam et al.	]		
ľ	$\neg$	3	5427174	1995-06-27	Lomolino et al.	]		
lÌ		4	5436793	1995-07-25	Sanwo et al.	]		
ľ		5	5459099	1995-10-17	Hsu	]		
ľ		6	5508234	1996-04-16	Dusabion, Sr. et al.	]		
ĺ		7	5514832	1996-05-07	Dusabion, Sr. et al.	]		
lī	$\neg$					1		

file://G:\!IDS-E-Filed\COOL01600\COOL01600B\COOL01600B-usidst.xml

4/28/2004

Page 3 of 3

5514906 1996-05-07 Love et al. 5544696 1996-08-13 Leland 1996-08-20 10 5548605 Benett et al. 5575929 1996-11-19 Yu et al. 12 5579828 1996-12-03 Reed et al. 5585069 1996-12-17 Zanzucchi et al. 13 1997-06-24 Kaltenbach et al. 14 5641400 5692558 1997-12-02 Hamilton et al. 5696405 1997-12-09 16 Weld 5703536 1997-12-30 Davis et al. 18 5704416 1998-01-06 Larson et al 5727618 1998-03-17 Mundinger et al. 19 20 5759014 1998-06-02 Van Lintel 5763951 1998-06-09 Hamilton et al. 21 5774779 1998-06-30 Tuchinskiv 5800690 1998-09-01 Chow et al. 23 24 5801442 1998-09-01 Hamilton et al. 5835345 1998-11-10 Staskus et al. 25 5836750 1998-11-17 1999-01-12 Soane et al. 5858188 27 5863708 1999-01-26 Zanzucchi et al. 5869004 1999-02-09 Parce et al. 29 5870823 1999-02-16 Bezama et al. 1999-02-23 Sakamoto 31 5874795 5876655 1999-03-02 32 33 5880017 1999-03-09 Schwiebert et al. 5880524 1999-03-09 5901037 1999-05-04 Hamilton et al. 1999-08-10 Tauchi 36 5936192 37 5940270 1999-08-17 Puckett 5942093 1999-08-24 Rakestraw et al 38 39 5964092 1999-10-12 Tozuka et al. 5965001 1999-10-12 Chow et al. 40 41 5965813 1999-10-12 Wan et al.

Information Disclosure Statement

file://G:\!IDS-E-Filed\COQL01600\COQL01600B\COQL01600B-usidst.xml

5978220 1999-11-02

4/28/2004

Information Disclosure Statement

$\Box$	43	5997713	1999-12-07	Beetz, Jr. et al.
$\Box$	44	5998240	1999-12-07	Hamilton et al.
$\Box$	45	6007309	1999-12-28	Hartley
	46	6010316	2000-01-04	Haller et al.
	47	6013164	2000-01-11	Paul et al.
	48	6019882	2000-02-01	Paul et al.
	49	6054034	2000-04-25	Soane et al.
	50	6068752	2000-05-30	Dubrow et al.

# Signature

xaminer Name	Date

Frey et al.

## UNITED STATES PATENT AND TRADEMARK OFFICE ACKNOWLEDGEMENT RECEIPT

Electronic Version 1.1 Stylesheet Version v1.1.1

Title of Invention	APPARATUS AND METHOD OF FORMING CHANNELS IN A HEAT-EXCHANGING DEVICE
--------------------	--

Submission Type:

Information Disclosure Statement

Application Number:

10/643684

\*10/643684\*

EFS ID:

59983

Server Response:

Confirmation Code	Message
ISVR1	Submission was successfully submitted – Even if Informational or Warning Messages appear below, please do not resubmit this application
ICON1	4600
ISYS5	Filename= N/A BusinessRule= Validation System/Function Call Information. #Supporting Msg:Server unable to validate the Confirmaton/Application numbers at this time. They will be checked by PTO personnel later.

First Named Applicant:

Thomas Kenny

Attorney Docket Number:

Timestamp:

2004-04-28 14:28:45 EDT

From:

us

File Listing:

Doc. Name	File Name	Size (Bytes)
us-ids	COOL01600C-usidst.xml	9504
us-ids	us-ids.dtd	7763
us-ids	us-ids.xsl	12026
		,

file://G:\!IDS-E-Filed\COOL01600\COOL01600C\COOL01600C-xmre.xml

4/28/2004

Acknowledgement Receipt

Page 2 of 2

package-data	COOL01600C-pkda.xml	1714
package-data	package-data.dtd	27025
package-data	us-package-data.xsl	19263
	Total files size	77295

Message Digest:

Name:

700eeb07255651feb9069db794a16ed908a15233

Digital Certificate Holder cn=Thomas B. Haverstock,ou=Registered Attorneys,ou=Patent and Trademark Office,ou=Department of Commerce,o=U.S.

Government, c=US

Transmittal

TRANSMITTAL

Page 2 of 2

COOL01600C-usidst.xml

Documents being submitted

us-ids

Transmittal

Page 1 of 2

us-ids.dtd us-ids.xsl

Electronic Version v1.

Stylesheet Version v1.1.0

APPARATUS AND METHOD OF FORMING CHANNELS IN A HEAT-EXCHANGING DEVICE Invention Title of

Comments

\*10/643684\* 10/643684 Application Number:

Thomas Kenny 2003-08-18 First Named Applicant:

4600 Confirmation Number:

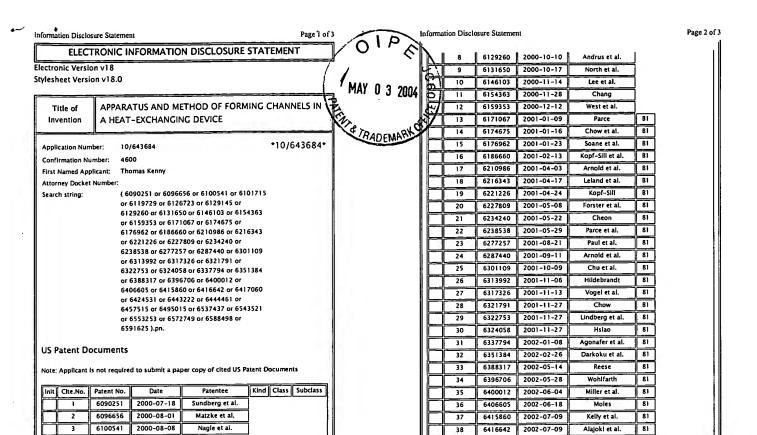
Attorney Docket Number:

or other use besides the filing of official correspondence by authorized parties between patent applicants or their representatives and the USPTO. Fraudulent I hereby certify that the use of this system is for OFFICIAL correspondence is strictly prohibited, and subject to a fine and/or imprisonment under applicable law.

application noted in the submission. This document(s) will become part of the I, the undersigned, certify that I have viewed a display of document(s) being using either the USPTO provided style sheet or software, and that this is the electronically submitted to the United States Patent and Trademark Office, document(s) I intend for initiation or further prosecution of a patent official electronic record at the USPTO.

Submitted by:	Elec. Sign.	Sign. Capacity
Thomas B. Haverstock	/tbh/	
Registered Number: 32571		Attorney

file://G:\!IDS-E-Filed\COOL01600\COOL01600C\COOL01600C-pkda.xml



file://G:\tIDS-E-Filed\COOL01600\COOL01600C\COOL01600C-usidst.xml

2000-08-15

2000-09-19

2000-10-03

2000-10-10

Fuesser et al.

Oberholzer et al.

Drost et al.

Yamamoto et al.

6101715

6119729

6126723

6129145

5

4/28/2004

file://G:\!IDS-E-Filed\COOL01600\COOL01600C\COOL01600C-usidst.xml

6444461 2002-09-03

2002-07-09

2002-07-23

2002-09-03

39

41

6417060

6443222

Tavkhelidze et al.

Bhatti et al.

Yun et al.

Knapp et al.

81

81

81

4/28/200

43	6457515	2002-10-01	Vafal et al.	81
	6495015	2002-12-17	Schoeniger et al.	18
	6537437	2003-03-25	Galambos et al.	B1
46	6543521	2003-04-08	Sato et al.	ВІ
47	6553253	2003-04-22	Chang	₿1
48	6572749	2003-06-03	Paul et al.	BI
49	6588498	2003-07-0B	Reysin et al.	B1
50	6591625	2003-07-15	Simon	81
e	F	er Name		Dat

\*10/643684\*

# UNITED STATES PATENT AND TRADEMARK OFFICE ACKNOWLEDGEMENT RECEIPT

Electronic Version 1.1 Stylesheet Version v1.1.1

Title of Invention

APPARATUS AND METHOD OF FORMING CHANNELS IN A HEAT-EXCHANGING DEVICE

Submission Type:

Information Disclosure Statement

Application Number:

10/643684

EFS ID:

59986

Server Response:

Confirmation Code	Message
liiCV/D1 .	Submission was successfully submitted – Even if Informational or Warning Messages appear below, please do not resubmit this application
ICON1	4600
ISYS5	Filename= N/A BusinessRule= Validation System/Function Call Information. #Supporting Msg:Server unable to validate the Confirmaton/Application numbers at this time. They will be checked by PTO personnel later.

First Named Applicant:

Thomas Kenny

Attorney Docket Number:

Timestamp:

2004-04-28 14:30:01 EDT

From:

us

File Listing:

Doc. Name	File Name	Size (Bytes)
us-ids	COOL01600D-usidst.xml	2431
us-ids	us-ids.dtd	7763
us-ids	us-ids.xsl	12026

file://G:\!IDS-E-Filed\COOL01600\COOL01600D\COOL01600D-xmre.xml

4/28/2004

Page 2 of 2

Acknowledgement Receipt

package-data	COOL01600D-pkda.xml	1714
package-data	package-data.dtd	27025
package-data	us-package-data.xsl	19263
	Total files size	70222

Message Digest:

e439afa61847e03b8a5cd44e988dbfef8d8abb8c

Digital Certificate Holder cn=Thomas B. Haverstock,ou=Registered Attorneys,ou=Patent and Trademark Office,ou=Department of Commerce,o=U.S.

Name:

Government,c=US

Transmittal

Page 1 of 2

TRANSMITTAL

Electronic Version v1.1

Stylesheet Version v1.1.0

Title of APPARATUS AND METHOD OF FORMING CHANNELS IN A Invention HEAT-EXCHANGING DEVICE

Application Number: 10/643684 \*10/643684\*

2003-08-18

First Named Applicant: Thomas Kenny

Confirmation Number: 4600

Attorney Docket Number:

I hereby certify that the use of this system is for OFFICIAL correspondence between patent applicants or their representatives and the USPTO. Fraudulent or other use besides the filing of official correspondence by authorized parties is strictly prohibited, and subject to a fine and/or imprisonment under applicable law.

I, the undersigned, certify that I have viewed a display of document(s) being electronically submitted to the United States Patent and Trademark Office, using either the USPTO provided style sheet or software, and that this is the document(s) I intend for initiation or further prosecution of a patent application noted in the submission. This document(s) will become part of the official electronic record at the USPTO.

Submitted by:	Elec. Sign.	Sign. Capacity
homas B. Haverstock	/tph/	
egistered Number: 32571		Attorney

Transmittal Page 2 of 2

Documents being submitted Files

us-ids

us-ids.dtd

us-ids.xsl

Comments

**4**7

\*10/643684\*

**ELECTRONIC INFORMATION DISCLOSURE STATEMENT** 

Electronic Version v18

Stylesheet Version v18.0

APPARATUS AND METHOD OF FORMING CHANNELS IN Title of A HEAT-EXCHANGING DEVICE Invention

Application Number: 10/643684

Confirmation Number: 4600 First Named Applicant: Thomas Kenny

Attorney Docket Number:

( 6632655 or 20010016985 or 20010024820 or Search string:

20010044155 or 20010045270 or 20010046703 or 20010055714 or 20020011330 or 20020134543 ).pn.

**US Patent Documents** 

Note: Applicant is not required to submit a paper copy of cited US Patent Documents

iņit	Cite.No.	Patent No.	Date	Patentee	Kind	Class	Subclass
	1	6632655	2003-10-14	Mehta et al.	B1		

### **US Published Applications**

Note: Applicant is not required to submit a paper copy of cited US Published Applications

init	Cite.No.	Pub. No.	Date	Applicant	Kind	Class	Subclass
П	ī	20010016985	2001-08-30	insley et al.	Αī		
	2	20010024820	2001-09-27	Mastromatteo et al.	Αl		
	3	20010044155	2001-11-22	Paul et al.	Αl		
	4	20010045270	2001-11-29	Bhatti et al.	Αl		
	5	20010046703	2001-11-29	Burns et al.	Αl		
	6	20010055714	2001-12-27	Cettour-Rose et al.	Al		V
	7	20020011330	2002-01-31	Insley et al.	Αl		
	8	20020134543	2002-09-26	Estes et al.	Al		

Signature



file://G:\tIDS-E-Filed\XXFILES\COOL\COOL\_jr\_1\COOL01600%20e-Filed%2004-... 4/28/2004